

SPECIAL POSTER: Supersonic Transports

AIR & SPACE

Smithsonian • November 1995



ON
LINDBERGH'S
WING

RUNWAYS OF FIRE

How to launch a jet
from the back of a truck

NASA's
Cave
People



\$3.50 U.S./\$4.50 Canada





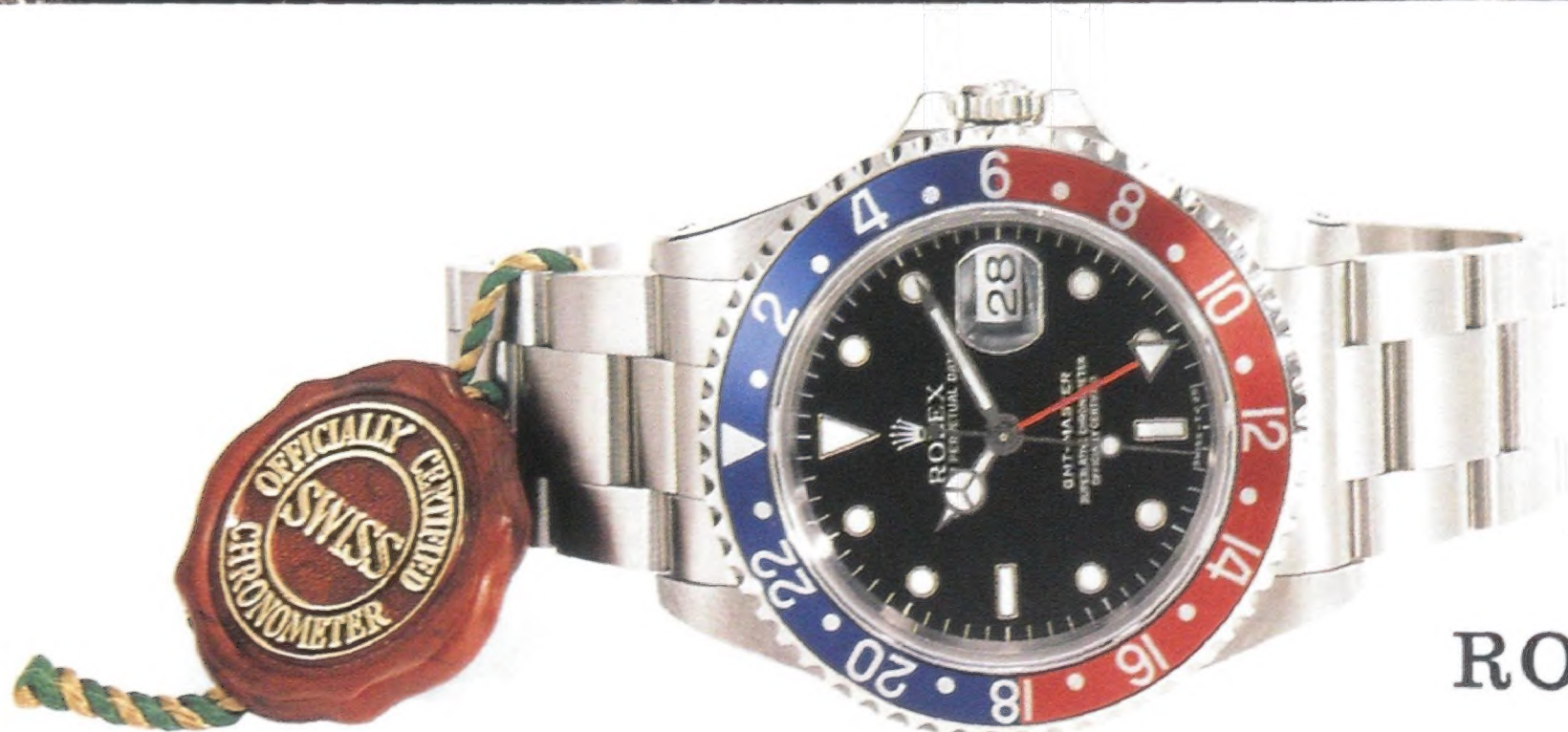
**“A pilot has to believe in his equipment.
That’s why I wear a Rolex.”** *Chuck Yeager*

Throughout his remarkable career, Chuck Yeager has shown an uncanny talent for what pilots call “pushing the edge of the envelope.”


At 21, only three years after first boarding a plane, Yeager was leading a squadron of fighter pilots in World War II. And at the age of 24, he became the first person to fly faster than the speed of sound.

Yeager remains a man on the move. “I don’t jump off 15-foot fences anymore,” says Yeager, “but I can still pull 8 or 9 G’s in a high-performance aircraft.”

In all his exploits, Yeager depends on a rugged and reliable timepiece. “I wore a Rolex more than 40 years ago when I broke the sound barrier and I still do today,” says Yeager.



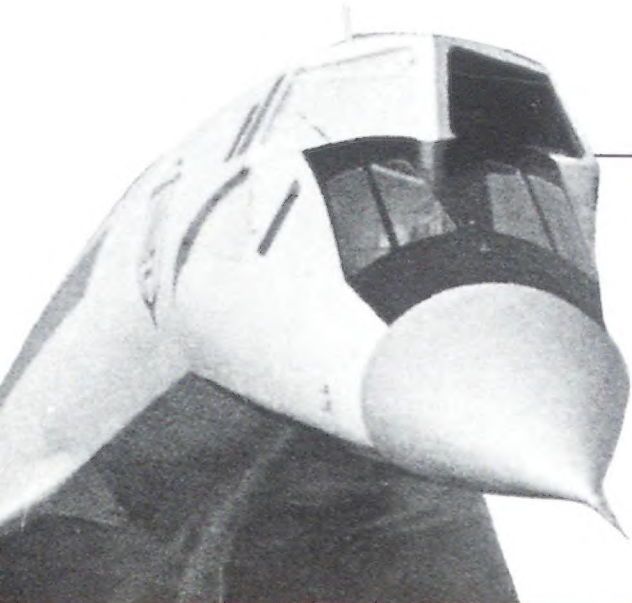

ROLEX

Rolex Oyster Perpetual GMT-Master Chronometer in stainless steel with matching Oysterlock bracelet.
Write for brochure. Rolex Watch U.S.A., Inc., Dept. 777, Rolex Building, 665 Fifth Avenue, New York, N.Y. 10022-5383.
Rolex, , Oyster Perpetual, GMT-Master and Oysterlock are trademarks.

AIR & SPACE

Smithsonian

CONTENTS



Special Poster: The SSTs

Once they were rivals.
And while there is talk of a
next-generation supersonic
transport, for the time being
the Tu-144 and the Concorde
are still the world's only SSTs.



40

26 **Encore for an SST** by Tom Huntington

One of the former Soviet Union's Tu-144s is getting a new lease on life as the centerpiece of a U.S. program.

34 **Homecoming** by Stephan Wilkinson

Illustrations by Web Bryant

Two Germans were searching for a buried World War II aircraft. What they found was a 50-year-old grave.

40 **Astronomy's Hot Spot** by Donald Goldsmith

Photographs by Ann Hawthorne

The South Pole can be a harsh place to work, but astronomers find that it has a great view.

48 **Passage to Vietnam** by Henry Scammell

Photographs by Geoffrey Clifford

In a land still scarred by war, U.S. air carriers are jockeying for a share of Vietnam's airline market.

58 **Commentary: Goodbye Yellow Brick Road** by David R. Hinson

The FAA's administrator outlines a revolutionary way to make air transport more efficient.

60 **Descent to Mars** by Jon Krakauer

Photographs by David Harris

Is there life on Mars? A team of NASA scientists venture deep inside the earth to look for clues.

Reflections on the Cold War:

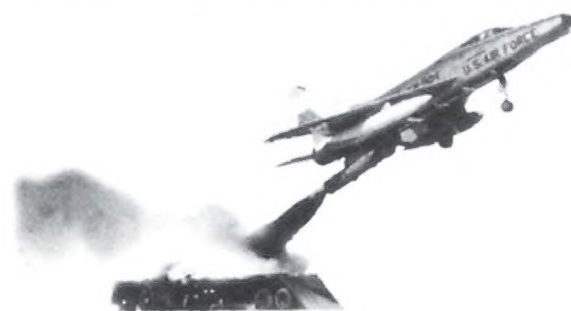
Fifth in a Series

68 **Runways of Fire** by Ed Regis

No runway? No problem. A 1950s Air Force program devised a daring alternative.



60



Cover:

An F-100 Super Sabre demonstrates its independence from runways in a photograph provided by Rockwell.

Departments

4	Viewport	78	Sightings
6	Letters	82	Reviews & Previews
10	Soundings	88	Credits
18	In the Museum	89	Calendar
20	Above & Beyond	91	"The Satellite Sky" Update
24	Flights & Fancy	91	Forecast
47	The Smithsonian Traveler	92	Collections

AIR & SPACE/Smithsonian (ISSN 0886-2257) is published bimonthly by the Smithsonian Institution, 900 Jefferson Drive, Washington, DC 20560. ©Smithsonian Institution, 1995. All rights reserved. Reproduction in whole or in part without permission is prohibited. Editorial offices are at 370 L'Enfant Promenade SW, 10th Floor, Washington, DC 20024.

Advertising and circulation offices are at 420 Lexington Ave., New York, NY 10170. SUBSCRIPTION PRICES: United States and possessions: \$18 a year. Canada and all other countries add \$6.00 for each year. Eighty-five percent of dues is designated for magazine subscription. Current issue price is \$3.50. Back issue price is \$5.00. MAILING LISTS: From

time to time we make our subscriber list available to companies that sell goods and services by mail that we believe would interest our readers. If you would rather not receive such mailings, please send your current mailing label or exact copy to: AIR & SPACE/ Smithsonian, Mail Preference Service, PO Box 53261, Boulder, CO 80322-3261. SUBSCRIP-

TION SERVICE: Should you wish to change your address or order new subscriptions, you can do so by writing AIR & SPACE/Smithsonian, PO Box 53261, Boulder, CO 80322-3261, or by calling 1-800-766-2149. Postmaster: Please send change of address to AIR & SPACE/ Smithsonian, PO Box 53261, Boulder, CO 80322-3261.

"I LOVE THE SMELL OF



JET FUEL IN THE MORNING."

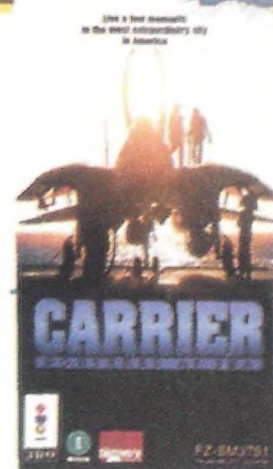
An Experience from the REAL 3DO Zone™, Eddie "Ah-Choo", NH

CARRIER FORTRESS AT SEA

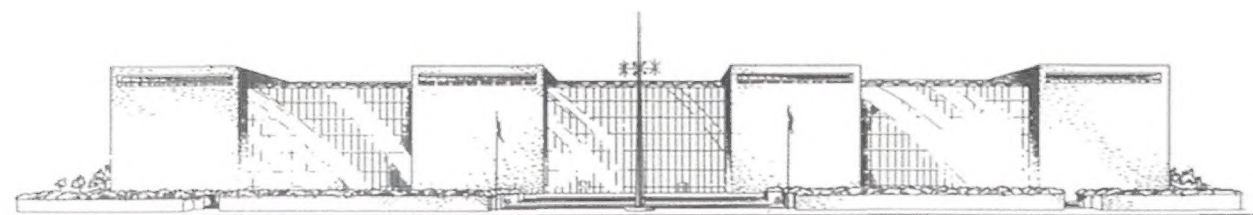


"I'm pullin' 3D days sea duty on the Carl Vinson nuclear aircraft carrier. I can check out the aircraft, listen to the crew, sit behind the controls. Really see what makes this thing tick. 3D graphics, realistic sound, and incredible film clips are all under my thumbs. I can even try landin' an F-14 on this thing. You try bringin' down a screaming Tomcat on a postage stamp doin' the hula. Hey, it's not just a CD. It's an adventure." ■

HOOK UP WITH YOUR NEAREST 3DO DEALER OR CALL: 1-800-332-5368



Panasonic
Software Company



Motion and Memory

When you first saw the cover of this issue, you may have wished that magazines would find a way to add motion to their photography. Well, we have good news for you.

We first looked into doing a story on North American Aviation's Zero-Length Launch flights after hearing test pilot Al Blackburn speak at one of the National Air and Space Museum's monthly General Electric lectures. But Al not only talked about his experiences at North American, he showed movie footage taken during his tests with the F-100 Super Sabre.

It occurred to us that this was a natural story for *Air & Space/Smithsonian*, but one that couldn't be fully told in print. To get a sense of what these flights were really like, you need motion and sound. You need a video.

We asked Blackburn to participate in a video that would appear simultaneously with the story, and he said yes. As it happened, an experienced producer, Larry Wells, and a veteran ABC newsman, Jim Slade, had recently left network television. Slade had shot a number of his telecasts from the Museum, and he was well known to the staff. Both Wells and Slade have a lifelong interest in aviation, and when they heard about Blackburn's test flights and then saw the original film, they couldn't wait to start production.

Now the video is ready to take its place beside the print story, and *Air & Space* readers will have the first opportunity to obtain the video "Runways of Fire" directly from us. Information on how to order follows the article.

Like so many events in the short history of aviation, the story behind "Runways of Fire" might have been lost to time. Most of the individuals who were part of the Zero-Length Launch program are retired, as Al Blackburn is. Fortunately, he preserved the record of the flights to share with future generations, and this video will ensure that it's available for years to come.

With the aerospace industry engaged in some of the biggest mergers in its history, a lot of people who worked on

projects like the ZEL program worry that their stories may be lost. Companies make an effort to preserve their own histories, but with the pressure to cut costs, archives are sometimes one of the first things to go. After a merger, management often wants to change the internal culture to set the newly formed entity off on a new track.

It's a little unfair to expect corporate America to preserve its own past when it's constantly being told to look to the future. To management, there's nothing less interesting than *last* year's widget. Fortunately, human nature intercedes, and project teams often rescue the last example of some system nobody else remembers. It was their baby, after all, and *they* remember.

Museums can't handle the load, and numerous offerings to the National Air and Space Museum have to be respectfully declined by the staff because there's simply no room. Says Museum archivist Thomas Soapes, "When we accept something, we assume responsibility for it in perpetuity." Soapes says that about once a year, the Museum is asked to save some massive corporate collection from being dumped in a landfill. After one such recent call, Soapes sent a curator to check out the treasure trove. When he returned, the curator gave a brief but eloquent report: "Great collection. But it's also the size of our total holdings."

One of the best reasons for preserving the past is to avoid the waste of reinvention (something many companies ought to weigh against the cost of keeping archives). Since flying F-100s off a flatbed trailer, Al Blackburn has told his story to hundreds of people, but no one has adopted the idea. If anyone ever does, at least he won't have to start from scratch.

Air & Space magazine's charter is to publish, and when we deal with aerospace history, we find and preserve the stories that don't reside in archives—at least not in story form. We do it with words and pictures—and now, with video.

—George C. Larson

AIR & SPACE

Smithsonian

Secretary of the Smithsonian Institution
I. Michael Heyman

Editor
George C. Larson

Managing Editor
Tom Huntington

Senior Editor
Linda Musser Shiner

Departments Editor
Patricia Trenner

Senior Associate Editor
Perry Turner

Associate Editors
Karen Jensen
Diane Tedeschi

Photography/Illustration
Caroline Sheen

Art Director
Phil Jordan
Gretchen Lessing

Publisher
Ronald C. Walker

Administration
Carey O. Randall, Associate Publisher

Advertising
Louis C. Kolenda, Director

Circulation
Liberta Abbondante, Director
Gale Page, Assistant Director
Caroline Topak, Marketing Director
Elizabeth Hopkins, Planning Director

Production
Sarah D. Kingsley, Manager
Sue Nixon

Business
Shelia Perry Brannum, Manager

Founder
Walter J. Boyne

Publisher Emeritus
Joseph J. Bonsignore

WILLIAM S. PHILLIPS



“THE DREAM FULFILLED,
WHERE THE LOVE LIGHT SHINES”

A limited edition fine art print created with up to 24 colors on archival paper.
1750 signed by the artist and consecutively numbered. 34"w x 18"h \$195 U.S.

Available only through authorized Greenwich Workshop® dealers.
For more information, please call 1-800-859-3474 in the U.S. or 1-800-263-4001 in



THE GREENWICH WORKSHOP, INC., One Greenwich Place, Shelton, Connecticut 06484-4675 • (203) 925-0131

THE GREENWICH WORKSHOP LTD., 3781 Victoria Park Avenue, Unit 6, Scarborough, Ontario M1W 3K5, Canada • (416) 490-8342

GREENWICH WORKSHOP EUROPE, Greenwich Place, Severn Drive, Upton upon Severn, Worcester WR8 0JT, England • Phone: 01 684 594409 • Fax: 01 684 594405

Secretary of the Smithsonian Institution
I. Michael Heyman

Board of Regents
Smithsonian Institution

Ex Officio
Chief Justice of the United States
William H. Rehnquist, Chancellor
Vice President of the United States
Albert Gore Jr.

Appointed by the President
of the Senate
Honorable Thad Cochran
Honorable Daniel P. Moynihan
Honorable Alan K. Simpson

Appointed by the Speaker of the House
Honorable Sam Johnson
Honorable Bob Livingston
Honorable Norman Y. Mineta

Appointed by Joint Resolution of Congress
Honorable Jeannine Smith Clark
Honorable Barber B. Conable Jr.
Dr. Hanna H. Gray
Dr. Manuel L. Ibáñez
Mr. Samuel C. Johnson
Dr. Homer A. Neal
Mr. Frank A. Shrontz
Mr. Wesley S. Williams Jr.

Contributing Editors, Air & Space/
Smithsonian

Michael Beschloss	Nick Kotz
Roger Bilstein	Saunders B. Kramer
William E. Burrows	W. David Lewis
Eric Chaisson	Stephen Maran
Tom Crouch	Laurence Marschall
David DeVorkin	Ted Maxwell
Ron Dick	Ron Miller
Freeman Dyson	James Oberg
Daniel Ford	Edwards Park
Greg Freiherr	Dominick Pisano
Sylvia D. Fries	Robert E. Pollack
Owen Gingerich	Fred Reed
Donald Goldsmith	George Robinson
Stephen Jay Gould	Theodore Robinson
George Greenstein	Marcia Smith
William Gregory	Robert W. Smith
R. Cargill Hall	Jill Tarter
Richard Hallion	Steven L. Thompson
Jim Hansen	William Triplett
Gregg Herken	Albert Van Helden
Richard H. Kohn	G.L. Verschuur
Nick Komons	Stephan Wilkinson

Tough Love

I was a gunner on B-29s, and "The Last Raid" (Aug./Sept. 1995) reminded me of the missions we flew after the surrender, bringing supplies to prisoner-of-war camps in Japan. We flew at dangerously low altitudes, and as we passed overhead, the Japanese would stand amazed in the middle of the streets. Streetcars stopped, and every passenger would head for a ditch. People fell from their bicycles, or out of their boats. No one had ever seen a B-29 at treetop altitude before.

—Guy Longshore
La Grange, Georgia

Just over two weeks after the attack described in "The Last Raid," our POW camp at Rokuroshi, Japan, experienced an air raid, albeit a friendly one. On September 2, B-29s flew over the camp and released "comfort packages"—pairs of 55-gallon steel barrels containing supplies. Each had a parachute, but many of them split, and those barrels came down like bombs. Six or seven went through the roofs of our camp buildings. Others hit the ground, plunging five feet into the dirt. One Japanese guard had his arm broken. Still, we were thankful for the hundreds of pounds of canned food,

sugar, chocolate, cigarettes, and clothing. For starving prisoners, that was truly manna from heaven.

—Robert G. Bjoring
Menlo Park, California

The Unkindest Cut

In the late 1960s, my dad operated a mobile welding business in Tucson, and he and I would pay regular visits to the area's aircraft salvage yards. While Dad toiled in the sun repairing or modifying the smelter, I watched crane operators chop airplanes into pieces with blades similar to that described in "Death of the Beast" (June/July 1995). The great chunks of mangled metal that were left would then be bulldozed into the gaping hole of the smelter hopper.

The solid steel blades were constantly breaking or chipping from the force needed to sever the aircraft, so my father was called upon to devise an alternative. After several trials, Dad came up with a laminated blade constructed of several layers of thinner sheet steel welded together so as to enable the blade to flex. That design served as the standard for many years.

Looking back, I feel great admiration



for the skill and experience Dad used in solving these kind of problems. But as a pilot and a great admirer of the aircraft of history, I sometimes wish those involved hadn't been so determined to make room for the flying machines of the future.

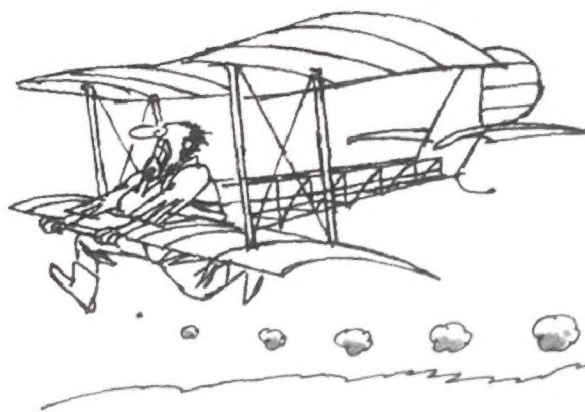
—Bill Barnier
Hilton Head Island, South Carolina

Did Kee Bird Have to Die?

The idea of retrieving the B-29 *Kee Bird* was a noble one, and working in the frozen wasteland of Greenland clearly presented many hardships ("Up in Smoke," Soundings, Aug./Sept. 1995). But what possessed Darryl Greenamyer to take unnecessary chances with a priceless piece of our aviation history? Instead of taking the macho, Indiana Jones approach of trying to get the aircraft up and flying, Mr. Greenamyer could have disassembled, crated, and shipped it back for reassembly and restoration.

If Mr. Greenamyer ever decides to make right on his monumental error in judgment, I for one would volunteer to help disassemble the remains of the priceless bomber. I'm sure many others would too.

—Peter J. Esterle
Uniontown, Ohio



York



"I added the doberman to help get him airborne."

Editors' note: A detailed account of Greenamyer's salvage attempt appeared in Smithsonian magazine's September issue, not the August issue, as we had reported.

Something Rotten in the State of Alaska

I was appalled by "The Magnetic North" (Apr./May 1995). I have been associated

with the guiding and air taxi businesses for the past 23 years, and these industries do not need the type of publicity this article gives them.

I am not familiar with the particular businesses or pilots described, but in south-central Alaska we do not have rotting moose carcasses or caribou meat lying around in hangars. Our local Fish and Wildlife protection officer would have a field day, and someone would be jailed.

Medallions shown smaller than actual size.

APOLLO/SOYUZ
STAFFORD-BRAND-SLAYTON
ДЕЖУРОВ-СТРЕКАЛОВ

An art perfected centuries ago, cloisonné is born of fires as hot as those generated by spacecraft re-entering Earth's atmosphere, eternally fusing glass-like porcelain to solid brass layered in precious 24k gold.

Announcing the
**Official Insignias of
Apollo-Soyuz
and Mir-Shuttle
Cloisonné Medallions**

Medallion Display Card is shown smaller than actual size of 3 7/8 by 7 1/2 inches and is an artist's concept.

ORDER TODAY!

BHDL-67VE

**The Official Insignias of
Apollo-Soyuz
and Mir-Shuttle
Cloisonné Medallions**

★ Limited Edition of 10,000
★ Orders accepted in strict sequence of receipt

Fleetwood • Cheyenne, Wyoming 82008-0001

Please accept my order as follows:

QUANTITY _____ The Official Insignias of Apollo-Soyuz and Mir-Shuttle Medallions in Display Card, \$20 each _____ \$ _____
Price includes shipping and handling.

I prefer to pay as follows:

☐ Directly. I enclose my check or money order for \$ _____ payable to Fleetwood as full payment.
☐ By Credit Card. Please charge my payment to my:
☐ MasterCard ☐ Visa ☐ American Express
☐ Discover Card ☐ Diners Club

Card No. _____ Expires _____

Signature _____
ALL ORDERS SUBJECT TO ACCEPTANCE AND LIMITATION

Daytime Tel. No. _____
IN CASE WE HAVE A QUESTION ABOUT YOUR ORDER

Mr./Mrs./Miss/Ms. _____
CIRCLE TITLE PLEASE PRINT

Address _____

City _____ State _____ Zip _____

Use your credit card and order **TOLL FREE**
Phone 1-800-443-3232 Fax 1-800-628-3123
from anywhere in the U.S. and Canada.

Your order will be acknowledged. Please allow eight to 10 weeks after receipt of order for shipment.

Limited edition of 10,000

Twenty years ago, American astronauts and Russian cosmonauts met for the first time in space. The *Apollo-Soyuz* Joint Space Flight was a heartening moment of warmth during the Cold War era . . . and a promise for the future.

This year, Americans and Russians again rendezvoused in space — almost exactly 20 years to the day after that first happy encounter. The stunning success of the docking of Space Shuttle *Atlantis* with Space Station *Mir* is sure to be remembered as one of the great milestones in space exploration!

Now you can have a lasting reminder of both unprecedented space flights — the *Official Insignias of Apollo-Soyuz and Mir-Shuttle* Cloisonné Medallions, issued together in a limited edition of just 10,000. These shimmering medallions come to you in a special Medallion Display Card that features authoritative information about these visionary space flights, at the original issue price of just \$20. Call 1-800-443-3232 toll free or mail the order form today.

In addition, air taxi operators are under close observation by the Federal Aviation Administration; they do not fly all day and drink all night.

If all the information in the article is true, charges are due and should be brought quickly.

—Thelma Schrank
Gakona, Alaska

Park at Own Risk

I was the lead design engineer for Thor control systems at Douglas Aircraft, and I recall the Thor that went straight up ("The Rockets' Red Glare," Flights & Fancy, Aug./Sept. 1995). The main engine came almost straight down and landed on a parked automobile, fortunately unoccupied. The M.P. first on the scene had the presence of mind to ticket the vehicle for parking in an unauthorized location. Thus, he relieved the Air Force of any liability.

—Duncan Pitman
Tahoe City, California

Gun Control

In "A Pacific War Album" (Aug./Sept. 1995) the photo caption on page 65 states: "Gunners and ammunition were left behind on night missions so that more fuel and bombs could be carried." Gunners did come along on night missions. They did not have guns or ammunition because when we were flying without running lights over the target



area we did not want to shoot one another. But the gunners came anyway. There was a sentimental notion that the crew would fly intact so that we all would end our tour together.

—Alfred K.B. Tsang
Indianapolis, Indiana

That Nagging Flea Problem

Your response to Norman Rubin's letter in the Apr./May 1995 issue did not emphasize the crucial difference between the Flying Flea and the freewing ("Spratt, Schmittle, and Freewing," Dec. 1994/Jan. 1995). The reason the Flea stalled was that its hinged front wing had to be adjusted manually by the pilot. (Imagine trying to keep a weather vane lined up with the breeze by adjusting it manually, rather than letting it adjust itself.) The freewing, on the other hand, is constantly free to set its own angle of attack, which

makes it "autostable" and therefore safe from stalls and spins.

—Hugh Schmittle
Freewing Aerial Robotics Corp.
College Park, Maryland

I married the youngest daughter of Charles A. Fauvel, a test pilot, airplane designer, and one of the founders of the first French team that tested airplanes scientifically. When the Flying Fleas were declared unsafe, Fauvel was designated to test fly them. He told me that the only reason the Fleas were crashing was that the builders, who knew nothing about aeronautics or flight mechanics, were not balancing them correctly—their center of gravity was too far aft. When they were built in accord with designer Henri Mignet's instructions, however, the Fleas were totally safe.

—Erik de Lapparent
Lagny, France

Some Holes in the Story

I enjoyed your short piece on Denver's new airport (Sightings, June/July 1995). It is a lovely sight. I wanted to get a picture of it from a distance, but a rainstorm made the sky too dark to use my zoom lens.

Once inside the airport, however, its beauty dissolved as we got a look at all the buckets that had been set up to catch the rain coming through the roof.

—E. Witter Stone Jr.
Foxboro, Massachusetts

Corrections

Aug./Sept. 1995 Letters: We regret misreporting Chief Master Sergeant George E. Coleman's rank.

"Whole Lotta Jumpin' Goin' On," p. 62: The top picture shows a Stearman; the bottom, an N3N.

"A Pacific War Album": The photograph on pp. 72-73 shows Guam, not Iwo Jima.

Address letters to: Letters, Air & Space/Smithsonian, 901 D St. SW, 10th Floor, Washington, DC 20024. Please type or print clearly, and include your daytime phone number.

Letters will be edited for publication. Air & Space is not responsible for the return of unsolicited photographs or any other materials.



"Sorry, this is spin control. Mission control is down the hall."

e-mail You must include your full name and daytime phone number.
America Online: airspacedt,
Compuserve: 75361,3425, Internet:
airspacedt@aol.com.

ANYONE CAN SEE THIS IS A BETTER CAMCORDER.

**SHARP
VIEWCAM**

Anyone can see this is an easier, more fun way to record events. After all, Sharp Viewcam lets you see your world through a big, color view screen, not a tiny black and white viewfinder.

You hold it in your hands, not stuck to your eye, so you have freedom to see, record and be a part of what's going on.

Now you'll get shots you'd miss with an ordinary camcorder.

**SHOOT AND
PLAY BACK INSTANTLY
ON THE SAME
BIG COLOR
VIEW SCREEN.**

And only Sharp Viewcam has a lens that pivots 270°

**UP TO A \$200
REBATE** When You Buy A Sharp Viewcam
Offer Expires January 2, 1996

LCD

so you can shoot from any position or angle and even put yourself in the picture. Plus, play it back instantly, in full color with sound. All in all, Sharp Viewcam is the most fun you can have with a camcorder. But, anyone can see that.



SPINS, TURNS AND TWISTS. NOT STIFF AND RIGID



CALL
1-800-BE-SHARP

SHARP
FROM SHARP MINDS
COME SHARP PRODUCTS™

OUT WITH THE OLD CAM. IN WITH SHARP VIEWCAM.

©1995 Sharp Electronics Corporation. Simulated Screen Image.

A Tree Grows in Brookings



CURRY COASTAL PILOT/WILLIAM SCALES

Eighty-four-year-old Nobuo Fujita could not contain his delight as he stepped off the wing of the Beechcraft Bonanza that had rolled to a stop on a little airstrip in Brookings, Oregon, last May. Clapping his hands and laughing, he shouted a Japanese equivalent of "Wheel!"

Fujita had just gotten his first aerial look at the Oregon forest since two historic but little-known days in 1942, when he piloted the only enemy aircraft to penetrate the continental United States and drop bombs.

The aircraft he had just exited was flown with the help of a former foe: Glenn Woodfin, a U.S. Air Force veteran of World War II. Woodfin made the takeoff and landing but let Fujita take the controls while airborne for a reenactment of his bombing runs over the forest.

Fujita made his wartime flights in a floatplane launched from the Japanese submarine I-25, which surfaced off the southern Oregon coast. The Yokosuka

E14Y1—which Fujita, an engineer, had helped design—had a top speed of 100 mph. Fujita fully expected to be shot down. "I was convinced that with my slow floatplane there would be no chance for me to escape, once spotted by American fighter planes guarding these shores," Fujita said. "And I must say that I was convinced too that there would be more than enough planes waiting for me upstairs after the takeoff from my mother ship."

Fujita left the submarine to bomb the Siskiyou forest on September 9 and again on September 29. A third mission was canceled because the submarine's commander believed the sub had been spotted. The plan was to set the forest on fire and cause panic among Americans in retaliation for General James Doolittle's bombing of Japan in April 1942. Three of the four 168-pound phosphorus bombs that Fujita dropped failed to explode. Rain and fog protected the forest from the

incendiary fourth bomb, and the fire it produced was spotted before much damage was done.

Nevertheless, Fujita, a retired industrialist, wanted to help mend the scars left by World War II. Over the past 30 years, he has befriended the town near the bomb site, paying visits, making donations, and extending apologies. During his most recent visit, Fujita placed his family's 400-year-old samurai sword in the town's new library. The sword, which was strapped to the seat of his aircraft during the bombing runs, was presented to the city on Fujita's first visit, when he was brought over by the Jaycees to be honorary grand marshal of the 1962 Azalea Festival, despite some local criticism.

Three years ago, Fujita offered his apology to the forest. On the eve of the 50th anniversary of the September 9th bombing that caused the fire, he hiked into the forest and planted a redwood seedling. This year, he had planned to hike back to the site, but his doctor had forbidden it. Last May, as Fujita flew overhead in the Bonanza, several people hiked into the forest in his stead. The group heard Fujita's message from U.S. forest ranger Mike Frazier. "I offer my deepest prayers now for the repose of all those who had died in the war," Frazier read. "But I pray too for this commemorative tree of the friendship and peace to live through hundreds of years to come and grow into the tallest reflection of our mutual pledge for friendship and peace."

—Marjorie Woodfin

The Plot Heard Round the World

While Marine Corps helicopters fluttered in to snatch Scott O'Grady from the Bosnian countryside last June, a flight of F-16s prowled overhead to provide weaponry if the rescue went bad. In the cockpits were the downed pilot's buddies from Aviano, a U.S. airbase in Italy.

Zulu (a nickname O'Grady earned because of his difficulty with Greenwich,

or "Zulu," time) had been on the run for a week. He'd be hungry or scared, and perhaps a bit out of it. And there was a chance his radio calls had been faked by Bosnian Serbs trying to lure another airplane into range of their surface-to-air missiles. Emotions in those cockpits were running high.

Scott Zobrist was one of the F-16 pilots. Back at Aviano after the rescue, Zobrist sat at his computer, composed an e-mail message about the mission, and sent it to 13 military friends. His dispatch was joyful, jargon-laced, and shot through with adrenaline: "The helos were inbound, authenticating Zulu (they asked him what he was called in high school when he got drunk!) With a good ID they moved in, had Zulu pop some smoke, and picked him up. The whole thing from the authentication to the pick-up was about 10 minutes (seemed like an eternity). To hear comm [radio traffic] like, 'Basher 52, got you in sight,' was pretty moving, especially after thinking for most of the week that Zulu was a mort [dead man].... I've never been choked up in the jet before, but I was this morning."

The online service CompuServe processed the message at 7:33 p.m. eastern time on June 8. At 3:57 the next morning, one of the recipients forwarded



the message to 14 of his friends. And so it went, from captain to captain ("Let's hear it for the good guys!"), from captain to colonel ("Sir, FYI"), around the world and back again. In a few days the message had turned up in hundreds if not thousands of electronic mailboxes, on an Internet newsgroup for military aviation buffs, and on America Online, with upwards of three million subscribers.

Predictably, the Air Force wasn't pleased with Captain Zobrist's fling at



creative

writing. A

Pentagon official

grumbled that the dispatch "was more detailed and more in-depth than what intelligence sources were providing under classified covers." Well...perhaps. I asked some military people to point out security breaches, and no one was able to. My guess is that what really bugged the brass was Zobrist's salty language. To a connoisseur of military prose, of course, that's precisely what makes it such a vivid read.

In the end, Zobrist got off with no detectable damage to his career. It seems that the Pentagon doesn't have a specific rule against disseminating sensitive information by e-mail, an oversight that will presumably be rectified.

O'Grady got a book contract from Doubleday and plans to leave active duty for the Air Force Reserve, where he will help in recruiting drives and speak at survival courses. He'll have a ghost writer and plenty of Air Force oversight for his book and I look forward to the result, but I suspect that the best piece of writing about the rescue has already been published, in cyberspace.

—Daniel Ford

UPDATE

Freewing Makes a Sale

Freewing Aerial Robotics and Matra Défense have won a contract from the French navy to deliver an unmanned Scorpion Tilt-Body ("Spratt, Schmittle, and Freewing," Dec. 1994/Jan. 1995), which will serve aboard a frigate as a reconnaissance craft. The Scorpion's vectored-thrust capability enables near-vertical takeoffs and landings.

Weightless in Wyoming

Director Ron Howard wanted realistic weightlessness sequences in his film *Apollo 13*, so he shoehorned cast, crew, and sets aboard NASA's KC-135 zero-gravity trainer. Nicknamed "Vomit Comet" for its ability to induce space sickness, the modified refueling tanker flies high-altitude parabolic arcs to give passengers the sensation of zero-G spaceflight.

Now zero G has come to the masses. Using a modified Sabreliner business jet to fly parabolas, Weaver Aerospace of Jackson, Wyoming, gives customers as much as 15 minutes of zero G a day, racked up 25 seconds at a time, just like the NASA jet does. Weaver is the first—and so far the only—company in the business.

"Zero G is hard to describe, but it's not like anything you've ever done," says spokesman Rand Simberg. "It's not like falling, because after entry your stomach achieves equilibrium and that discomfort goes away. Everybody who does it wants to do it again."

Right now the people doing it are mostly researchers. For example, engineers recently went up to test a new propellant system for McDonnell Douglas' proposed space shuttle successor, the Delta Clipper. But a handful of thrill seekers with deep pockets are also signing up. Prices start at \$1,950 for a one-day introductory course and climb astronomically from there.

"We're open to people who want to do it for the hell of it," Simberg says. In fact, he sees this as a first step for a booming space tourism industry. What's the second step? "Probably suborbital rocket rides," he says. "Possibly by the end of the decade."

—Phil Scott

The New Piper

Another general aviation corporate rebound was announced in Washington last August as the former Piper Aircraft Corporation emerged from reorganization under court protection as the New Piper Aircraft, Inc. Within a stone's throw of the Capitol, where Congress recently enacted a law protecting general aviation manufacturers from limitless product liability lawsuits, the company's chief executive officer, Charles M. Suma, told a gathering of reporters and industry officials that the newly "aggressive" Piper would challenge its competition with boosted production and new models "incorporating cutting-edge technologies."

The company's majority owner is Philadelphia-based investment firm Dimeling, Schreiber and Park, which holds three seats on the New Piper board. Teledyne Industries, Piper's largest creditor and the manufacturer of the



Continental engines used in many light aircraft, holds two seats.

"Watch the skies," Suma urged the assembled in a phrase reminiscent of old UFO films. "We will be the manufacturer that launches the next generation of small aircraft." Piper is the second of the once mighty Big Three of general aviation—the other two are Cessna and Beech—to relaunch itself in the light airplane arena. After the burden of lawsuits caused a total shutdown of production, Cessna recently began construction of a plant that next year will begin anew, starting with the popular Model 172 Skyhawk. Piper entered bankruptcy in July 1991 after years of decline and changes in ownership. Raytheon's Beech has maintained production throughout the slump.

The company was founded in 1937 by William T. Piper, whose business plan was based on mass-producing relatively inexpensive airplanes for the average working family. Today the company no longer builds even a variant of its flagship, the Cub. Its most advanced product is a pressurized single-engine airplane, the Malibu Mirage.

—George C. Larson

SLC-6's First Launch Fizzles

The first launch from Space Launch Complex 6 at Vandenberg Air Force Base in California ("Spaceport West," Apr./May 1986) ended abruptly last August when the first Lockheed Launch Vehicle-1 and its payload, a \$3 million data communications satellite, had to be destroyed over the Pacific when the rocket went out of control two minutes after liftoff. Shortly after SLC-6 opened for business as an Air Force shuttle launch site in 1986, the site was mothballed when the shuttle program was suspended after the breakup of the *Challenger*.

Ground Zero, New Mexico

Marjorie Spurlin had waited long enough. A half-century earlier, at age two, she was asleep in her family's home in Tularosa, New Mexico, when the world's first atomic bomb exploded 70 miles away at a God-forsaken patch of desert named Trinity Site.

The 19-kiloton blast went off at 5:29:45 a.m. Mountain War Time on July 16, 1945. Shock waves shattered windows 120 miles away. The successful test cleared the A-bomb for use against Japanese targets just three weeks later.

Today, the U.S. Army opens Trinity Site, which lies deep within the White Sands Missile Range, to tourists twice a year (see Collections, June/July 1992), yet Spurlin had never visited until last July, on the 50th anniversary of the Trinity test. "This brings back the fact that I really lived through a once-in-a-lifetime experiment—an event that changed the course of history," said Spurlin, now a fifth grade teacher in Gallup. Like many of the 5,300 anniversary visitors, Spurlin and her husband Jerry snapped photos of each other in front of a replica of Fat Man, the bomb that destroyed much of Nagasaki on August 9, 1945. Others climbed inside the rusting hulk of Jumbo, a 200-ton steel cylinder built to contain the Trinity blast if the TNT exploded the plutonium into bits instead of triggering its chain reaction. And a few poked around for beads of trinitite, a radioactive glass forged by the blast's intense heat (and received stern warnings from military police if they tried to pick it up).

Both at Trinity Site and in a revival tent just outside the missile range's Stallion Gate, many marked the anniversary of the exact moment of the explosion with

prayers. One man spattered "symbolic blood" on a stone obelisk that stands at ground zero. While dozens of reporters recorded the event, MPs handcuffed the protester and escorted him off the range.

The media throng included several Japanese TV crews. One, which was producing a documentary for Japan America Television, asked visitors for their reactions to graphic black-and-white photos of Hiroshima and Nagasaki



"Astronaut as Photographer: A Personal View of the Universe," an exhibit that opened last May at the National Archives in Philadelphia, features portraits of Earth, the moon, and fellow astronauts. Hoot Gibson's 1984 photo of Bruce McCandless strapped to Challenger's remote manipulator arm and Walt Cunningham's portrait of Wally Schirra aboard Apollo 7 in 1968 portray exhilaration as well as exhaustion. The exhibit, which will run through May 1996, also includes lunar rocks, space toys, rocket engine parts, and spacecraft models.

FINAL PRODUCTION RUN

THE 50TH ANNIVERSARY LIMITED-EDITION OFFICIAL A-2 FLYING JACKET

Act now to own this commemorative version of the jacket worn by our World War II flying heroes!

FINAL PRODUCTION RUN.

No more will be made after 1995.

Honoring Victory in World War II.

When the gallant pilots of the U.S. Army Air Corps took to the skies during World War II to defend freedom, they wore the legendary A-2 Leather Flying Jacket. The A-2 was lightweight and comfortable, yet "tough as nails" and identified its wearer as one of an elite breed of fighting men.

Announcing the final production run for *The 50th Anniversary Limited-Edition Official A-2 Flying Jacket*.

Genuine Military Issue. Not a Commercial Reproduction.

Cooper Sportswear was an original supplier of A-2 jackets during World War II and today still produces official military issue A-2's under contract to the Air Force. Now, for the last time, Cooper has agreed to produce *The 50th Anniversary Limited-Edition Official A-2 Flying Jacket*. This will be the final production run for this World War II Commemorative Edition. After 1995, it will never be made again. Each jacket is distinguished by a specially commissioned pictorial map lining. You will receive a Certificate of Authenticity stating that yours is an official A-2. *Not a reproduction and not a look-alike copy—this is the genuine article!* Available exclusively from Willabee & Ward.

Proudly Made in the U.S.A. to U.S. Air Force Specifications.

The *50th Anniversary Limited-Edition Official A-2 Flying Jacket* is made in the U.S.A., using material and production methods specified by the U.S. Air Force. Premium goatskin assures ruggedness and great looks. Official military issue details include knitted cuffs and waistband, regulation snap-down collar, shoulder epaulets, and roomy snap-close pockets.



Convenient Monthly Installments.

You can own this jacket for just \$259 (plus \$9.50 shipping and handling) payable in six convenient monthly credit card installments of \$44.75. Satisfaction is guaranteed. You can return the jacket in original condition within 30 days for exchange or refund. Available in even sizes 34-52 regular and long. Call about larger sizes (to 60) for \$50 more. (For best fit, order one size larger than your usual jacket size.) Questions about sizing? Call—we'll fit you over the phone. Order today! **But hurry...when they're gone, they're gone forever!**

Phone orders normally shipped next business day.



CALL TOLL-FREE: 1-800-367-4534
Extension 779-1108

RESERVATION APPLICATION

Willabee & Ward
47 Richards Avenue
Norwalk, CT 06857



Satisfaction
Guaranteed.

CALL TOLL-FREE: 1-800-367-4534
Extension 779-1108

Please send me _____ *50th Anniversary Limited-Edition Official A-2 Flying Jacket(s)*.

Size(s) (Even sizes 34-52): _____ ☐ Reg. ☐ Long

For each jacket, charge 6 monthly installments of \$44.75* to my credit card:

☐ VISA ☐ MasterCard ☐ Discover ☐ Am. Ex.

Credit Card No. _____ Exp. Date _____

Name _____

Address _____

City/State/Zip _____

Signature _____

☐ I prefer not to use a credit card and will pay by check. Enclosed is my check for \$259, plus \$9.50 shipping/handling, a total of \$268.50* for each jacket.

*Any applicable sales tax will be billed with shipment. Higher shipping/handling outside U.S.

victims. "I'm very impressed," said assistant director Hiro Knishi after several hours of taping. "We can see the American people's conscience. They really care about what happened at Hiroshima and Nagasaki."

"The Japanese cannot be proud of ourselves, what we did in World War II, and I don't think the Japanese people feel anger about the bombings. But we want to learn from history. We want to know what to do to prevent another bomb, another devastating war."

—*Diamond Benningfield*

UPDATE

More Historical Finds at Edwards Desert

After retrieving engine compressor blades with Martin inspection stamps and a rear view mirror from California's Edwards Air Force Base last August, aviation archeologists Tony Moore and Pete Merlin, assisted by the recollections of an eyewitness, have found what they say is the crash site of a Martin XB-51 bomber that went down in 1952 ("The X-Hunters," Feb./Mar. 1995). Also, citing a manufacturer's plate from an oxygen flow indicator and a fragment bearing a Bell Aircraft inspection stamp, the two believe they have located the site where the Bell X-1D crashed in 1951. That airplane had been jettisoned from the B-50 carrying it after catching fire prior to release.

NASA Launches New Mission Control

After having helped NASA keep its spacecraft aloft for 30 years, Houston's mission control has been forced into retirement. Replacing it is the new mission control, a \$250 million center that will monitor manned spaceflight well into the next century.

Following thousands of hours of testing, the facility took control of *Discovery* last July after the shuttle deployed its payload. Launches and landings will be handled by the old mission control until the new center proves itself glitch-free.

Compared with the old mission control, just a few hundred yards away, the new mission control has smaller rooms with flat instead of stepped floors and a layout that lets controllers break into small teams. Aesthetically, the new setup has more of a sleek "Star Trek" ambiance than its boxy predecessor, says John Muratore, chief of the control center systems division.

Replacing the huge custom-built mainframe computer that drove monochrome monitors is a high-speed fiber optic cable network of 200 Digital Equipment Corporation workstations with full-color graphic capability. The upgrade will enable the center to control a space shuttle and the proposed space station simultaneously, but at \$30 million less each year than the old mission control.

"The new center is a wonderful place, and there's a lot to be said for it because it is so versatile," says Christopher Kraft, who was NASA's chief flight director in the 1960s and retired as director of the Johnson Space Center in 1982. "But the things that happened on two floors in old mission control were history, and they had a great deal to do with the future of spaceflight."

Indeed, one room has been declared a National Historic Landmark and preserved as it was during Project Apollo. The other, however, will be dismantled, and the mainframe computer equipment will be distributed among NASA facilities nationwide.

—*Phil Scott*

You Can't Keep a Good Spyplane Down

Sitting outside a Lockheed Martin Skunk Works hangar in Palmdale, California, was a sight to behold: not merely an SR-71

UPDATE

DAILY ADVANCE/JEFF HUTCHENS

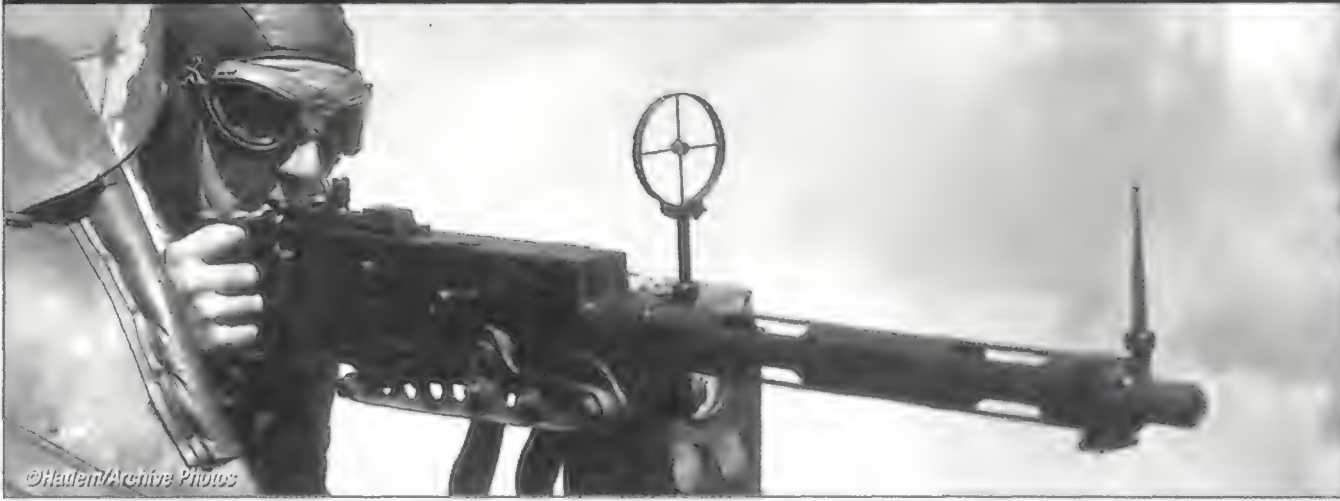


A fire that was accidentally started by a cutting torch destroyed a World War II airship hangar and the Westinghouse Sentinel 1000 airship in Weeksville, North Carolina, last August ("Lighter Than Air, Loaded for Bear," Soundings, Oct./Nov. 1991). Several surveillance blimps belonging to the TCOM, L.P. company were also lost in the blaze. The fire spread from one end of the plywood-covered building, where workers were repairing a support beam, to the other in 10 minutes. One of two naval airship hangars built on an air station in the early 1940s, the hangar, one of the world's largest wooden structures, housed the prototype Sentinel 1000, three TCOM blimps, and production equipment. Total damage is estimated at \$30 million. The remaining hangar, which escaped unscathed, houses a furniture factory.

in all its sleek, matte black glory, but an SR-71 that was about to come out of retirement and return to Air Force duty. Five years after budget cuts had removed the world's fastest airplane from Air Force duty, two Blackbirds were being pulled out of storage to be refurbished and reactivated.

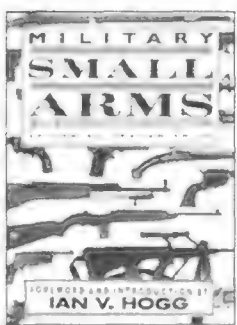
After a brief ceremony under the roasting desert sun last June, the ownership papers and keys—in the aircraft's distinctive shape—were handed over to Brigadier General Bill Rutledge, commander of the new Blackbird unit, which is stationed at Edwards Air Force Base in California. Pointing to his six

ACES AT 6 O'CLOCK!

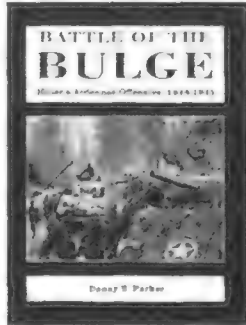


There's just *one* way to make sure you have the best books on land, sea and air warfare. You can't miss when you zero in on *The Military Book Club*®!

Take
4 for 98¢
with membership



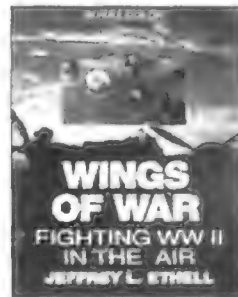
0364 \$34.95x



6452 \$34.95



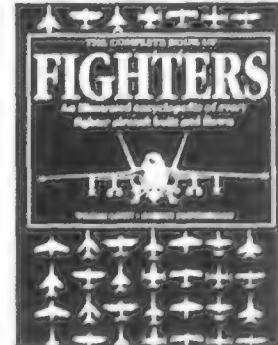
1370 \$15.95



1305 \$39.95



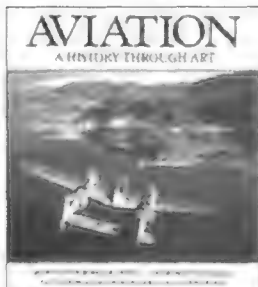
7781 \$35.00



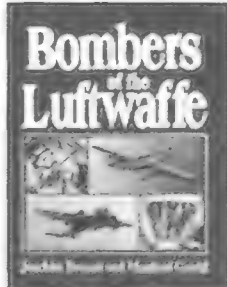
0943-9999* \$59.98



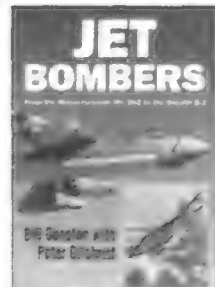
1230 \$24.95



3350 \$45.00



5249 \$29.95



0323 \$39.95



0075 \$29.95



0653 \$24.95



1412 \$29.95



1891 \$23.00



0950 \$29.95



0471 \$29.95



3905 \$29.95



0018 \$24.00



0133 \$22.00



5223 \$23.95



4754 \$24.95



4721 \$12.95x



6429 \$12.95x



1172 \$25.00



3004 \$12.95x



1339+ \$12.95



5777 \$35.00



1446 \$29.95



0216 \$29.95



4481 \$27.95



1511 \$27.50



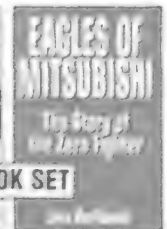
7989 \$29.95



1503 \$23.95



1529 \$26.90



2-BOOK SET

HERE'S WHAT YOU GET WHEN YOU JOIN...

A GUARANTEE OF SATISFACTION. Once your membership's accepted, we'll send your 4 BOOKS. If you're dissatisfied with the books, return them within 10 days at our expense. Membership will be canceled; you'll owe nothing.

THE FREE CLUB MAGAZINE. You'll receive up to 16 issues a year. Each reviews the Featured Book Selection(s) plus dozens of alternate books.

SHOPPING MADE SIMPLE. To get the Featured Book Selection(s), do nothing—it will be sent automatically. If you prefer another book—or none at all—return your Member Reply Form by the specified date. A shipping and handling charge (and sales tax, where applicable) is added to each order.

HUGE DISCOUNTS ON HARDCOVER BOOKS. Save as much as 30% off publishers' edition prices. Club books are sometimes altered in size to fit special presses.

AN EASY-TO-MEET OBLIGATION. Take up to 2 years to buy 4 more books at regular low Club prices. Afterwards, you may resign membership anytime.

RISK-FREE RETURN PRIVILEGES. If you get an unwanted book because your Club magazine was delayed and you had less than 10 days to respond, simply return the book at our expense.

Prices shown are for publishers' hardcover editions. Club hardcover editions save you up to 30%.

* Counts as 2 choices x Special edition exclusively for Club members - Softcover

THE MILITARY BOOK CLUB

Your #1 Source for Military Books

MAIL TO: The Military Book Club
c/o Book Express
P.O. Box 9157
Indianapolis, IN
46206-6357

Please write your numbers here:

YES! Please enroll me in The Military Book Club according to the risk-free membership plan described in this ad. Send me the 4 BOOKS I've indicated. Bill me just 98¢, plus shipping and handling.

SAVE EVEN MORE! Send me this book now and reduce my commitment to 3 books. Bill me an added \$3.99, plus shipping and handling. Books that count as 2 choices are not eligible.

(Write book numbers)

67471			41

42

If you select a book that counts as 2 choices, write the first 4 digits of the book number in one row of boxes and 9999 in the next.

Mr./Mrs.

Miss/Ms.

Address

Apt.

City

State

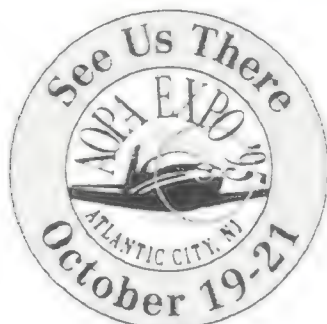
Zip

Members accepted in U.S.A. only. Sales tax added where applicable. We reserve the right to reject any application.

ASP 10/95



THE AOPA EXPO '95 ATLANTIC CITY - THE SUPERSONIC CONCORDE EVENT



FOR
ONLY
\$850.00*



Dear Aviation and Concorde Enthusiasts

Concorde. A mythical name all over the world; a dream for most, a once-in-a-lifetime experience for a few. Everyone recognizes her, even those who see her fly overhead every day stop to watch in awe and hope that maybe one day....!

Now this day is coming soon. For the very first time the Air France - ASA AeroSpace Concorde will be in Atlantic City during the AOPA Expo '95. Take this unique chance and fly once in your life with one of the aviation legends: the Supersonic Concorde.

We offer the following programs

Concorde Supersonic Experience Flights with Air France - ASA AeroSpace, October 20 & 21, 1995
Concorde Supersonic Discovery flight from the Atlantic City International Airport over the Atlantic Ocean back to ACY (per person, excluding taxes): \$850.00*

- ☐ Departure Friday October 20, 1995 from Atlantic City 4:35 PM
- ☐ Departure Friday October 20, 1995 from Atlantic City 7:00 PM
- ☐ Departure Saturday October 21, 1995 from Atlantic City 8:20 AM

*No discounts are applicable

On board we will offer you our premium service with champagne. Also you will have the opportunity to visit the cockpit during the flight and to take pictures. Each participant will receive a personal signed "Supersonic Flight Certificate." Call now, the available seats are very limited.
See YOU on board!

ASA AEROSPACE MAKES YOUR DREAM BECOME REALITY

FOR RESERVATION CALL THE AOPA TRAVELERS CLUB AT 800-888-2672

For information and questions call the ASA AEROSPACE Infocenter at 1-800-272-5050

ASA AEROSPACE is also the provider for flights with the outstanding SUHKOI-30 Fighter-Interceptor as well with MIG Fighters. Also available are public Space Training. Call the ASA AEROSPACE Infocenter for more information.

AOPA TRAVELERS CLUB REBATE DOES NOT APPLY.

Concorde availability based on advanced ticket sales

pilots and reconnaissance systems operators, he said, "Yes, all lieutenant colonels, probably the highest-ranking detachment in the history of the Air Force."

The Blackbird deserved nothing less. "It has a mystique unlike any other airplane," says Lockheed technical data engineer Bill Majors. "The first time I saw a stainless steel wind tunnel model of the SR, I thought it was something out of Buck Rogers. And if you've ever seen an SR take off, that's something you'll never forget."

The SR-71 first flew in 1964 (the Lockheed test pilot for that flight, Bob Gilliland, was at the transfer ceremony) and remained in operation until the aircraft were grounded in 1989. The Air Force loaned three Blackbirds to NASA for research, and most of the remaining 17 became exhibits. But at least two were rescued from permanent museum duty last year when Congress allotted funding to return a limited number of SR-71s to reconnaissance duty and the Air Force awarded a \$30 million contract to Lockheed Martin to refurbish a pair. The program has been running so smoothly that Lockheed Martin is offering to refurbish a third SR-71 for a mere \$3 million, down \$1 million from previous estimates.

Most of the people who had helped build the Blackbirds have long since retired. The company took the unusual step of bringing several of them, like Bill Majors, back to work. For much the same reason, Air Force officials wanted pilots and backseaters with Blackbird experience. "When they asked me if I wanted to return, I said, 'You bet,'" says Tom McCleary. "Along with the power, I've always been impressed by the nimbleness of the airplane. The cockpit is full of '60s technology—lots of switches and dials." He grins. "But it sure gives you a great view."

—Preston Lerner

Channel Soaring

Cable television programs devoted to aviation, such as the "Wings" series on the Discovery Channel, draw sizable audiences. "Wings" has had 800,000 to a million viewers a night, and surveys indicate that aviation-related offerings rank third overall among audience preferences, after history and the outdoors. Now two groups of entrepreneurs are forming channels to provide focused programming exclusively for flying enthusiasts. Wingspan, based in Rockville, Maryland, and billed as the

HANDCRAFTED AVIATION DISPLAY MODELS

Over 300 Aviation Display Models Available

SHOWCASE MODEL CO.

P.O. Box 470, Dept. O/N-95-11
State College, PA 16804-0470

(800) 441-9524 - Orders
(814) 238-8571 - Catalogs
(814) 238-8572 - FAX



Northrop/USAF F-89D
Scorpion (1/48th)
@ \$129.95+7.50 S/H

WORLD'S LARGEST MAKER OF AEROSPACE REPLICAS

Aviation Channel, is headed by former National Air and Space Museum director (and this magazine's founder) Walter Boyne. The Air & Space Network, under chairman Matthew E. Simek, is currently based in Portland, Oregon but plans to relocate to the Washington, D.C. area.

Wingspan held a press conference at Washington's National Press Club early last April to announce its intention to broadcast documentaries, educational content, and forums tied to events affecting the aerospace community. Boyne, along with Phil Osborn, president of the Network Group, which produced the "Wings" series, said that Wingspan will succeed because "the full interest in aviation has never been fully exploited." Wingspan would tap into a "vast fund of materials," including the Network Group's own extensive archives, to produce "programming with a passion," Boyne said.

Simek, who has been traveling around the country talking up interest in his Air & Space Network, says the new network will announce plans for a first-quarter 1996 launch at a press conference scheduled for New York City's Wings Club in mid-September. At start-up, programming would include aviation weather, a call-in program, and live space shuttle missions, among others. Entertainment would feature documentaries, theatrical films, air shows and other events, he said.

—George C. Larson

UPDATE

Luftwaffe to Invade Alamogordo

In a move reminiscent of the relocation of German scientists and engineers to New Mexico's White Sands Missile Range and then to Huntsville, Alabama, after World War II ("Coming to America," Aug./Sept. 1994), the German Luftwaffe will transfer some 300 personnel, 800 dependents, and a dozen Tornado fighter-bombers to a \$35 million military training center being built in Alamogordo, New Mexico. According to the *Wall Street Journal*, Alamogordo bankers, real estate firms, car dealers, and restaurants, anticipating the accompanying \$12 million payroll, are gearing up for a mini-boom in the local economy. If the program is successful, the German presence could triple in the next five years.

Oiled Cotton Mountain Parka



This jacket kept its occupant dry while studying mountain gorillas in Rwanda. Odds are very good it'll keep you dry. Unique features: Inside you'll find shoulder straps to slip your arms through before you enter the sleeve. If you get hot, just slide your arms out, let the coat slip off your shoulders and carry it like a pack. Just above each Velcro cuff is a plastic window, to check your compass/watch. The bright orange liner is the one thing we hope you never have to use, as it bears the international "Rescue" logo. Two huge bellows pockets fold before they snap, keeping everything in even if you take a tumble. On-seam zippers open to access the internal wind skirt without opening the jacket to the elements. Up top you'll find three more pockets, one zippered for security. The high density oiled-cotton shell with adjustable full hood throat latch parries the wind-driving rain. Zipper and lockable drawstring.



Special
Carry

Fabric from Scotland's high-

#3481-571 Dark Forest

After 92 years of being the principal outfitter to the world's most serious adventurers and outdoorsmen, we're pleased to offer you—without charge—our first catalog. Call 1-800-223-1408.

Willis & Geiger. Since 1902.

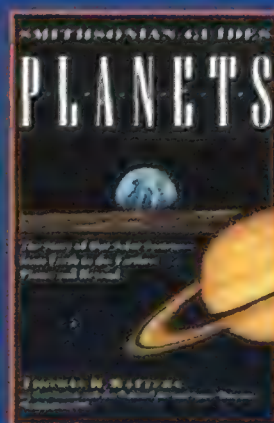
Experience
the Mystery
of
Space



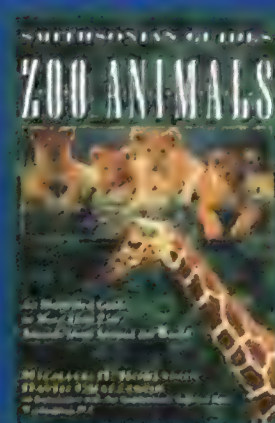
Explore
the Magic
of
Flight



Journey
to the
Heights of
the Solar
System



Venture
into the
Wilds of
the Animal
Kingdom



The Smithsonian Institution collections have thrilled millions of visitors with dramatic stories of human discovery. Now you can explore the worlds of science, nature and history in your own home with these boldly designed guides. Written by Museum curators and experts, these books are produced with the same standards of thoroughness, excellence, and entertainment for which the Smithsonian is known.

Available at bookstores or to order call 1-800-428-5331.

Hardcover \$27.50 • Paperback \$18.00

Macmillan Books

The Puzzling Past of the Nieuport 28

A Nieuport 28 is undergoing restoration at the National Air and Space Museum, and investigating its history is a bit like working out a family tree for Frankenstein's monster. When talking about the biplane's history, curator Peter Jakab treads cautiously: "This airplane or pieces of it," he says often, prefaced by "we think" and "at this time."

The airplane type—the N28C-1—is a French design that has three claims to fame in U.S. aviation history. It was the first fighter used by the American Expeditionary Force in World War I; the U.S. Navy used it from 1919 to 1921 for its first shipboard launching tests; and it flew in Hollywood films like *Dawn Patrol*. Yet the Museum's airplane has a tangled history and a jumbled identity—and at least five different serial numbers.

After the war, approximately 50 Nieuports were brought to the United States, and 12 were delivered to the Navy, which used them for shipboard launches. One of the first assumptions the Museum

staff made about its Nieuport was that at least pieces of it could have come from the Navy's supply of Nieuports. But Jakab's research volunteer, Ted Hamady, discovered that none of the serial numbers on the Museum's airplane match any of the numbers on the Navy aircraft.

Then the Nieuport's history gets really murky.

In the mid-1920s, a good number of the Nieuports brought back after the war were destroyed in crashes or worn out and disposed of. Some ended up with private individuals, many of whom shortened the wings for racing. By 1930, stunt pilot Garland Lincoln had acquired at least four Nieuport 28s to use in movies, the most famous being the 1930 World War I film *Dawn Patrol* and the better known 1938 remake. "Now it's pos-

sible that our airplane, or at least pieces of it, could have been one of those four," Jakab says. However, "one of the confusing things about it is all four of those aircraft had those clipped wings. Our airplane has the original-length, full-span wings—but it's possible that the fuselage could have been [from] one of those four."

In 1940, Lincoln sold his airplanes to movie stunt pilot Paul Mantz, who used



PETER M. BOWERS



CAROLYN RUSSO

In 1959, the Museum's Nieuport was restored to flying condition at the Old Rhinebeck Aerodrome in New York State (above). Today the Nieuport is being rebuilt by volunteers Robert Taylor, Jim Harrington, and Max Gainer (left to right).

them as non-flying props. Mantz almost certainly had a fifth Nieuport as well as additional parts, Jakab says. In a trade he made in 1957, Mantz gave parts of these airplanes to the late airshow operator Cole Palen. "Palen went down there and took the best wing panels and the best this and that and made one complete airplane," Jakab says. (This is the airplane the Museum now owns.) "So that's why it's so hard to know exactly what our airplane is because we don't know for sure if [any of] the parts we have came from that set of four that Garland Lincoln had, who gave them to Mantz, and then Mantz had some other parts. What we actually have is very hard to document."

The airplane changed even more in

Palen's hands. He constructed and installed numerous replacement parts when he restored it to a World War I configuration and flew it in airshows. In 1972 he retired the airplane to his museum. Fourteen years later the Museum traded Palen a still-flyable two-seat Nieuport trainer for the more historically significant Nieuport 28.

Considering the airplane's history, it seems appropriate that today its pieces are scattered around a workstation at the Museum's Paul E. Garber Facility in Suitland, Maryland. Rich Horigan, a senior preservation specialist in charge of the restoration, motions to the "airplane": a detached fuselage, about half cleaned and varnished, propped up between two sawhorses. Pieces of the rotary engine sit on metal shelves and inside inconspicuous boxes marked "pineapple chunks" and "green beans." The four wing pieces (with their four different serial numbers) are stacked on a shelf, and the landing gear sits in a corner. The firewall, sitting on a table above the propeller, is covered with oil, but Horigan hopes that an identifying number will be legible underneath the grime.

Aside from its bogus parts, Horigan says the Nieuport is in good shape compared to many of the aircraft that arrive at Garber. His team of volunteers

will continue cleaning all of the parts and then varnish the wood. When original parts are beyond repair or authentic pieces cannot be found, the Garber technicians will make faithful reproductions, Horigan says. The wooden fuselage and wings will be covered in new Belgian linen—the fabric applied by Palen had to be cut off because it had started to shrink, which damaged the airplane's structure.

The Nieuport's history—from 1995, at least—will be well documented. As Horigan and his volunteers take the airplane apart, they meticulously keep track of each piece, labeling and storing the ones they replace. Reproductions are stamped and dated so that future historians and restorers won't face the same puzzles as Jakab and Horigan.

"I think we're kind of getting to the point now where a lot of these questions, we're never going to know for sure," Jakab says. "So we're gathering as much information as we can."

Eventually, he'll have to make some educated assumptions and decide on the configuration, markings, and color the Nieuport will be given. At present, he plans to have the craft restored to resemble either a post-war trainer or a combat aircraft from one of the four U.S. squadrons that flew during the war. And

even though the manufacturing dates on the Nieuport's wings—late 1918 and early 1919—suggest that no part of the aircraft ever saw combat, Jakab is leaning toward using a wartime configuration. "The Nieuport 28 represents the first fighter aircraft that Americans flew in organized American squadrons. And that's why the type is significant," he says.

All of the Nieuport's pieces will be reassembled and ready for display at Garber in about a year and a half, Horigan says. The fragments of its history, however, may never be entirely pieced together.

—Sarah Scalet

Museum Calendar

Except where noted, no tickets or reservations are required. To find out more, call Smithsonian Information at (202) 357-2700, Mon.–Sat., 9 a.m.–4 p.m.; TTY: (202) 357-1729.

October 5 G.E. Aviation Lecture. "The Other Side of the Sound Barrier." Brigadier General Charles E. "Chuck" Yeager, USAF (ret.), returns to share the highlights of his colorful and history-making career. Langley Theater, 7:30 p.m.

October 7 Historian Tom Childers discusses how he researched his book *Wings of Morning: The Story of the Last American Bomber Shot Down Over Germany in World War II*. Lower level briefing room, 1:00 p.m.

October 21 Kite Aerial Photography Workshops. Beginners' class from 10:00 a.m.–noon, \$10; experts' class from 2:00 p.m.–4:00 p.m., \$50. Both classes will be taught by Craig Wilson and Brooks Leffler, who will show participants how to construct a camera cradle, attach the shutter timer, and launch the camera. To register, call Barbara Harrick at (202) 633-8926 or TTY (202) 357-1505.

Join the National Air and Space Society

The National Air and Space Museum invites you to become a founding member of the National Air and Space Society. Your support will help the Museum's efforts to build an extension at Dulles International Airport, which will display such artifacts as an SR-71 Blackbird, the space shuttle *Enterprise*, and the B-29 *Enola Gay*. To receive your membership packet, write to: National Air and Space Museum, Room 3733, MRC 321, Washington, DC 20560.

ARTIFACTS



In the early 20th century, images of flight frequently turned up on printed material of all kinds. These postcards are among a group that covers all of the major holidays. "You can really collect the history of aviation in postcards," says archivist Allan Janus of the National Air and Space Museum. Today the cards can be found at antique stores and flea markets, ranging in price from a quarter to \$10 and up. "They tended to be very well printed," says Janus. "A lot of them used a process called chromolithography, which was capable of doing very subtle color printing."

The Thanksgiving postcard, which was published around 1910, is part of the Museum archives. The Halloween postcard, published by S. Garre in Germany in 1909, is part of a collection of ballooning memorabilia that the Museum purchased in 1989.

On Lindbergh's Wing

In the last years of World War II, Biak was one of those little islands in the Dutch East Indies that was pounded mercilessly by big Navy guns before the Army and Marines landed. Then, of course, they pounded it some more.

I was one of the Fifth Air Force pilots who landed P-38 fighters on Biak in 1944, during General Douglas MacArthur's return to the Philippines. My outfit, the Ninth Fighter Squadron of the 49th Group, was designated an advance unit: We flew in and set up fighter operations as soon as the landing troops had beaten back the Japanese and secured the airfield.

When I climbed out of my cockpit, Army bulldozers were hurrying to build protective revetments for our aircraft. The drivers paid no heed to the gunfire resounding all around. Someone said the dozers made so much noise the operators couldn't hear the shooting.

Our support units set up tents along the coral reef at the edge of the airstrip. This would be our home until the next move on MacArthur's agenda. We moved every couple of months, but we were used to it, having moved all the way across New Guinea, from Port Moresby to the East Indies. What did bother us was our range problem, the vast distances to the various Japanese-held islands that would now be our targets. We were already at the limit of the P-38's 460-mile range, often returning from fighter sweeps with nothing but fumes in our gas tanks.

One day in August Major Wally Jordan, our squadron commander, called the flight leaders to a meeting. After we had all crowded into a musty tent, Jordan announced, "Fifth Fighter Command is

CHARLES A. LINDBERGH HOUSE



Lindbergh's flight was led by P-38 ace Tom McGuire (right).

planning on sending us on B-24 escort missions over a thousand miles out." Everyone laughed; even the major grinned. "Sure, Major, and that little Aussie gal I fell in love with in Sydney is comin' up on the next flight to spend the weekend," retorted a flight leader. Everyone laughed again. Then Jordan turned serious. "I'm not kidding, fellows. I wish I were."

"Major, how we gonna fly out a thousand miles?" asked the operations officer. "Even with our largest drop tank, we don't have that kind of range." Jordan nodded. "I know, Bill, but Command has a solution."

We all looked at Jordan suspiciously. "You're not going to believe this," Jordan went on, "but they've figured out

that we can extend our range by reducing RPMs."

"So what else is new," said the ops officer. "We already know that."

"Yeah. But they say we can pull our props back to 1,600 RPM." If the major had dropped a bomb in the tent it couldn't have been more explosive. "Sixteen hundred RPM!" someone yelled. "I can tell ya right now," said our engineering officer, "if you pull the RPM back that low on those Allison engines, they'll blow sky-high."

I didn't know quite what to think. I had always been told never to reduce the P-38's RPMs below 2,000—the fuel mixture could detonate prematurely and blow the cylinders. But at 21, I was the youngest flight leader in the squadron and thought it best to listen to the old heads (all of whom were also in their 20s).

"Whose crackpot idea did you say this was?" the ops officer asked.

Jordan rolled his eyes. "You're not going to believe this. The crackpot idea came from Charles Lindbergh."

It was deathly quiet for a moment. "Charles Lindbergh? The one who flew across the Atlantic?" someone asked, incredulous. "Yeah, that Lindbergh," Jordan confirmed. "Jesus, I didn't know he was still alive," someone said. "I knew he was alive," someone else said, "but I thought they were gonna put him in jail for being a Nazi."

I remembered hearing the same thing when I was in high school—that he was an isolationist who didn't want to get in the war, and that he'd been accused of Nazi sympathies when he accepted a German air medal from Hermann Goering

Your Best Value in a 1996 Desk Calendar!

FROM THE
SMITHSONIAN:
AN OUT-
STANDING
OFFER!

The Official 1996 Air & Space/ Smithsonian Desk Calendar

A genuine "exclusive" bargain produced in limited quantities, the 1996 edition of the official AIR & SPACE/SMITHSONIAN Desk Calendar will soon be ready for delivery. Printed entirely on heavy, burnished stock and richly hardbound, this distinctive desk accessory is more than a combination calendar and daily planner.

Featured throughout are over 50 rare photographs drawn largely from the National Air and Space Museum's famed archives and including many never published before. There's also detailed photo caption information and noted aviation anniversaries. Together, they capture the spirit of flight from its wood-and-wire beginnings to today's most advanced aircraft and space vehicles.

Available shortly, this special-edition 1996 desk calendar may be ordered for a modest \$9.95 plus \$3 for shipping and handling.

Quantities at this price are definitely limited. So order now to guarantee delivery in time for the holiday season.



**STRIKINGLY
ILLUSTRATED!
PHOTOS FROM THE
SMITHSONIAN'S NATIONAL
AIR AND SPACE MUSEUM
ARCHIVES!**

Please complete the form below and send in with your payment:



MAIL ORDER TO: Air & Space/Smithsonian, 901 D Street, SW, 10th Floor, Item #A96D, Washington, DC 20024.

FOR FASTEST SERVICE, phone 1-800-824-5974 toll-free to leave a recorded message with credit card information. You can fax credit card information to: 202-287-3163.

- | | |
|---|---|
| <input type="checkbox"/> one desk calendar @ \$12.95 (incl. S&H) | <input type="checkbox"/> two desk calendars @ \$25.90 (incl. S&H) |
| <input type="checkbox"/> This calendar order is for use as a 1995 holiday gift, please rush. | |
| <input type="checkbox"/> Check or money order enclosed (Make check payable to: Air & Space/Smithsonian) | |
| <input type="checkbox"/> Discover | <input type="checkbox"/> Mastercard |
| <input type="checkbox"/> American Express | <input type="checkbox"/> VISA |

Acct. # _____ Exp. Date _____

Signature _____

MAILING ADDRESS:

Name _____

Address _____

City _____ State _____ Zip _____

Please allow up to 4 weeks for delivery. Shipping of the 1996 Desk Calendar will begin November 1, 1995 to accommodate 1995 holiday gift orders.

**HAND CARVED
FROM SOLID
MAHOGANY**

**World's
Leading
Makers
of Fine
Aerosculptures**

Carved from mahogany by master craftsmen. Exquisitely hand painted markings and details.
Museum quality • Stand included
Size 16" to 22" • From \$99.50
Satisfaction Guaranteed



Pacific Aircraft

14255 North 79th Street, Suite 5
Scottsdale, Arizona 85260 • (602)991-1841



**PACIFIC
AIRCRAFT**

F-4U Corsair

P-38 Lightning

OVER
200
MODELS

**CALL (800) 950-9944
FOR CATALOG AND ORDERS**

ABOVE & BEYOND

for his New York-to-Paris flight. But I had refused to believe it.

"Well, if he is still alive, he'd be an old man, so what's he got to do with it?" a flight leader asked.

"Apparently he's got a lot to do with it because he's here," Jordan said.

"You mean here in the islands?"

"Yeah, he's over at Command, but he's coming over here."

"Jesus. What's he gonna do over here?"

"He's gonna show us how to do it."

Staring, disbelieving faces.

"How's he gonna do that?"

"He's gonna fly with us."

"In a P-38?"

"This whole thing is crazy. How can an old man like him fly with us in a P-38?"

Jordan shrugged. "I don't know. But that's the plan."

Like all squadrons, we had a scrounger. Ours, a fast-talking Italian kid from New York, had made a deal with the night watch guy on a Liberty ship anchored in the harbor. For a bottle of Aussie schnapps, the ship's watch threw a load of wood overboard after the captain had gone to bed. A bunch of us swam out, towed the wood to shore, and used it to build a small mess hall on the coral. It gave our island camp a little class. That's where I met Charles Lindbergh.

We were all sitting on the wooden benches in our classy new mess hall, smoking and talking, when he came in with a colonel. He was tall, but instead of the curly-haired and bright-eyed young man I remembered from pictures, the man I shook hands with was old. He had crow's feet at the corner of his eyes and his hair was turning gray. He wasn't thin anymore. I was terribly disappointed. To a 21-year-old, a 42-year-old is ancient.

He didn't say much, just that he was looking forward to flying with us to demonstrate the new fuel-saving technique that he and Allison had developed. He assured us that our engines would not blow sky-high. But the pilots were skeptical. So was I.

Our mission with Lindbergh, a 10-ship fighter sweep to Piroe Bay to search for a downed pilot and strafe the coast of Ceram, was scheduled for the next day. Intelligence said it would probably be a milk run.

At first I didn't know whether to be insulted or honored when Major Jordan told me he was putting me on Lindbergh's wing. After all, I was now a flight leader, not a wingman. "Keep an eye on him, Kirk, just in case the Zeros that aren't supposed to be there show up," Jordan said. "I don't want him to get shot down

Find out why *The New York Times* and
The Washington Post are quoting from this classic.

Augustine's Laws

Norman R. Augustine
CEO, Lockheed Martin Corporation

*An Irreverent Guide to Traps, Puzzles, and Quandaries
of the Defense Business and Other Complex Undertakings*

**GREAT
GIFT
IDEA!**

How do you keep your sense of humor in the crazy world of defense procurement and R&D projects? Keep a copy of *Augustine's Laws* by your side at all times!

All the long-standing myths, business clichés, traps for the unwary or naive, and complex entanglements one would ever face during a management career are completely explained in a series of witty maxims.



Exclusively sold by American Institute of Aeronautics and Astronautics

1984, 241 pp, illus, Hardback
ISBN 0-915928-81-7
AIAA Members \$24.95
List Price \$29.95
Order #: 81-7 (PB1)

Publications Customer Service
9 Jay Gould Ct.
PO Box 753
Waldorf, MD 20604
Fax: 301/843-0159
Phone: 800/682-2422

on my watch." After thinking about it, I realized it was a pretty big deal to be given the responsibility of seeing that Charles Lindbergh didn't get shot down.

Major Tom McGuire, commanding officer of the 431st Squadron, led our flight of four, with Lindbergh leading the second two aircraft. I had no trouble staying on his wing. There is a skill to leading as well as flying wing, and he had it. Lindbergh's timing and judgment were right on target for the join-up. He arched across McGuire's first circle and brought us sliding into a perfect element formation without a bobble. I caught a glimpse of McGuire's face when he glanced back at us: He looked astonished.

After we climbed to altitude and leveled off in loose formation, McGuire came on the radio and said, "Captive Flight, this is Captive Lead. Okay, let's pull 'em back...now."

We had been briefed on the procedure, but everyone cringed when we reached up and pulled back the prop levers until the twin tachometers showed 1,600. The formation wallowed around a bit as our airspeed dropped, and as the noise level also dropped, it seemed strangely quiet in those tiny cockpits.

Though normally we'd have radio silence in a fighter sweep, in this case we were allowed to communicate. But there wasn't much chatter. We all just sat there waiting for the first engine to blow. We weren't overly concerned—the P-38 had two engines. We could get home on one.

Our course took us west over New Guinea and out into the Ceram Sea. It was over water with no radio aids of any kind. We just took up a magnetic heading and hoped for the best.

We followed standard procedure on the outbound leg and burned fuel from our drop tanks first. If we got in a fight those tanks would be jettisoned. Because the drop tanks had no gauges, we had no way

of telling how much fuel we were saving—we wouldn't know until we ran them dry. When we finally switched to our main internal tanks, we had flown noticeably longer than usual. By the time we got to the target area some two and a half hours later, we had quite a bit more fuel than we normally did.

Storms obscured the west end of Ceram, so we turned back. Just before arriving over the coast we each armed and tested our four .50-caliber machine guns and 20mm cannon. I shifted around as much as the cockpit would allow to uncramp my muscles. Then I cinched the crash straps and flipped on my gunsight. Glancing across at Lindbergh's P-38, I saw that my ward seemed to be doing fine.

When we reached the coast Major McGuire gave the command to go to combat RPM. Our speed picked up and the cockpit noise increased to its familiar level. McGuire led us on a couple of sweeps around the area, but all that came up to challenge us was a little flak. Intelligence had called it right. Eventually we turned east, headed across the Ceram Sea, disarmed our guns, pulled our props back to 1,600, and settled down for the long flight home.

I'm sure there were some who were still waiting for an engine to blow, but most of us realized long before we landed at Biak that Lindbergh had been right: the reduced-RPM method worked well. It would indeed solve our range problem.

In April 1944, as a civilian technical representative for Chance Vought, Charles Lindbergh was sent to the Pacific theater to help test the F4U Corsair. He ended up flying 50 combat missions in the south Pacific in Corsairs and P-38 Lightnings. On July 28 he shot down a Mitsubishi Ki-51 fighter. His fuel-saving techniques increased the P-38's range by some 500 miles.

—Richard C. Kirkland

Although a civilian, Lindbergh managed to get some combat time in the P-38.



HERITAGE AVIATION ART

Images from the Sky...



THE BEST in aviation by the world's most accomplished and well known aviation artists. We represent the finest in aviation art prints by *Aerodrome Press, The Greenwich Workshop, The Military Gallery* and others.

TO ORDER OUR FULL COLOR CATALOG WITH CURRENT SUPPLEMENTS, send \$5, refundable with first purchase (U.S. Addresses) or \$10 (Outside U.S.). *All purchases are carefully packaged and guaranteed to arrive in perfect condition.*

HERITAGE AVIATION ART
12819 S.E. 38th Street, #211, Dept. AS
Bellevue, Washington 98006 U.S.A.
CALL 206/747-7429 or
1-800-331-9044



CAPTURE YOUR MEMORIES...



with a **custom** model of your favorite aircraft.

- Over 20,000 aircraft types available
- Your plane's paint scheme, tail #, etc.
- Hand carved from solid mahogany
- Completely handpainted—no decals at all
- Scale variations from 5 inches to 5 feet
- Engraving and logo on customized stand
- We accept Discover, MasterCard, American Express, Visa

Anderson Enterprises

405 Osage Drive, Derby, KS 67037
(Visit our story 5nm S of Wichita)

1-800-732-6875

Custom-built replicas—
second to none!



Poetic License

The late poet Howard Nemerov used to teach at Washington University in St. Louis. A tall, white-haired man with a slightly stooped and weathered elegance, he walked daily from his nearby University City home to his office. He was as unmistakable and predictable in his dress as he was distinctive and outrageous in his commentary. Nemerov's standard get-up was rumpled khaki pants and an azure blue jacket, over which was slung a knapsack that held books, papers, pens, and his ever-present cigarettes.

In the spring of 1989, Nemerov was in the second year of office as the nation's poet laureate, a position, he'd told a reporter, that he made up as he went along, "just like the rest of government." I was also in my second year, as a science writer for the university's public relations office. Occasionally as I passed him he'd look my way and smile; he was an approachable man, everyone had said, but I couldn't work up the nerve to say hello.

I never thought I'd get a meaningful word with him, but I finally did—at the Kennedy Space Center, on April 30, 1989. I was with a pool of reporters watching the countdown for the launch of the Magellan mission to Venus from the shuttle *Atlantis*. "Stay in the back and don't bother anybody," warned news director Dick Young, who referred to me as "the man from St. Lousy, Misery." "The tension builds up in here to launch time, and I can't have anybody getting in the way."

It was a clear, sunny day, perfect weather for a launch. At two hours to liftoff the place was buzzing, reporters working furiously on their laptop computers and NASA officials running to and fro. Then Howard Nemerov walked through the door with his bright blue jacket and half-grin. I leaped out of my seat and scrambled to the front of the newsroom. I stuck out my hand

and said, as if I had known him all my life, "Howard, what are you doing here?"

His eyes lifted, perhaps in recognition. "And what are you doing here?"

I told him, but before he could reciprocate, his NASA escort, a man named Goldman, according to his badge, joyously burst in, "This is the official poet of NASA and the poet laureate of the United States. He's here to write a poem for NASA to commemorate the event."

Nemerov raised his eyebrows, in tolerance, I thought. "I suppose there is something significant in all of this," he said, spreading his arms. "First time back to the planets and all of that. Another task for the poet laureate—none too small, nor large."

With that they were off, Goldman hauling Nemerov around the newsroom like a trophy. At about 90 minutes to launch, Nemerov, looking weary and in need of an escape, wandered toward

press row. I was thinking about his sense of humor and what he might have to say about the space shuttle. I asked if he'd like some fresh air.

We stood in the shimmering heat by the observation stand. Nemerov pulled out a crumpled pack of Pall Malls and lit up; I filled my pipe and did the same. "They're going to take me somewhere closer to the launching," he said, "where I can smell the fuel, feel the heat, hear the birds squawk—all the local color one needs for a poem, I guess."

I told him how much I admired his work and his background as a pilot in World War II. Working up to my question, I noted the great difference between the shuttle and the aircraft of the 1940s. "Oh yes, quite primitive by comparison," he agreed. "You'd go over the Channel, bumping all the way, and fly for hours to deliver the bombs. The actual contact with the enemy was very short, really."

"It must have been frightening," I said. "The aircraft were not always that reliable."

"Oh, we didn't think of that too much," he said. "Somebody had to stand up to Hitler and his gang. He was going to grab all of Europe and who knows what else."

"Have you followed the space program closely?" I asked. "What do you think of the shuttle, for instance?"

He paused and flashed that half-grin. "Do you really want to know?"

"Sure."

"I think it's the fastest way out of Florida."

We both roared with laughter. "That's not one you'll want me to give to those reporters in there, is it?" he asked. I shook my head. "I didn't think so," he said.

As it turned out, the countdown got to 31 seconds and stopped. I caught a ride home, but Nemerov was on hand for the May 6 launch. He later produced a poem titled "Witnessing the Launch of the Shuttle *Atlantis*," but he failed to achieve his professed goal: outliving the surgeon general. Nemerov died on July 5, 1991.

—Tony Fitzpatrick

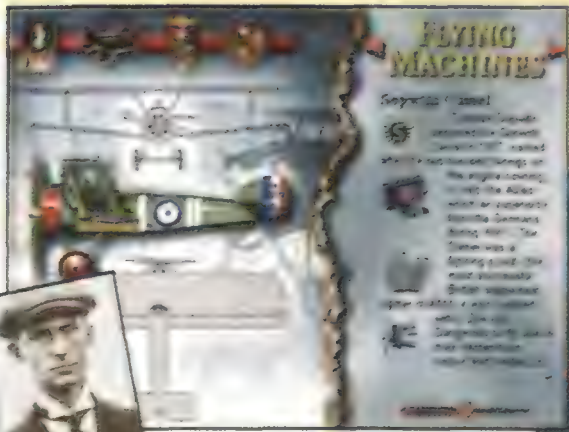


JOHN HEINIX

COME FLY WITH US.



For centuries, mankind dreamed of flying. Relive the fascinating journey with Dreams of Flight. This entertaining, informative and highly interactive CD-ROM chronicles the history of flight, from the Wright Flyer to the B-2 Stealth.



► Relive aviation's greatest moments with 50 minutes of historical film footage, 40 eyewitness accounts, 65 different 2-D aircraft illustrations and hundreds of photos, paintings and illustrations.



► Step into the cockpit and experience the thrill of a vertical barrel roll with the realistic acrobatic flight simulator.



Windows®
CD-ROM



Available now

CALL **1-800-262-7668** ext. 141
OR VISIT YOUR LOCAL RETAILER

CALL FOR INFORMATION ON MACINTOSH

The Soviet Union's Tu-144 supersonic transport never lived up to expectations. Today one of the craft is being given a second lease on life as a flying laboratory for a U.S. SST program. Below, representatives from NASA and several American companies prepare to give the program's Tu-144 a once-over.



TOM HUNTINGTON (LEFT); NASA (ABOVE); MIRAGENCY (RIGHT)



Encore for an SST

The Tupolev Tu-144 hasn't flown any passengers in almost 20 years, but U.S. researchers plan to exploit the one thing it still offers: supersonic speed.

by Tom Huntington



It was mid-winter cold, but after days of dense fog, the skies had finally cleared over the secret Zhukovsky Airfield near Moscow. Among the crowd that had gathered on this day were 80-year-old Andrei Tupolev, founder of the aircraft design bureau that bore his name, and Alexei, his son and heir. From one of the hangars a huge delta-wing airplane shaped like a sleek white dart was pulled out onto the ramp and prepared for flight. Its four enormous NK-144 afterburning turbojet engines were started, and after the airplane had taxied into takeoff position, it accelerated down the snow-covered runway, then lifted gracefully into the air. It was December 31, 1968, and the Tu-144 prototype had just become the first su-

personic transport in the world to fly, beating the European Concorde by a good two months.

By edging out its western rival, the Tu-144 became a solid propaganda coup for the Soviet Union, and as soon as the flight concluded successfully, the cloak of secrecy began to lift. A Soviet documentary about the flight said, in part, "This aircraft embodies all that is best in world science today."

Well, maybe.

The Tu-144, like many grandiose projects of the former Union of Soviet Socialist Republics, never lived up to expectations. Its thirsty engines compromised its range, a colossal air conditioning system to cool the hot aircraft assaulted passengers' ears, and in 1973 a Tu-

144 crashed at the Paris Air Show, creating a public relations disaster. Instead of a triumph, the Tu-144 became a Mach 2 white elephant.

But now Russian and American engineers are taking a second look at this nearly 30-year-old design. Not only are the two countries pooling their resources, with NASA leading the U.S. effort, but even rival airframe manufacturers Boeing, McDonnell Douglas, and Rockwell, along with engine makers Pratt & Whitney and General Electric, have teamed up. In September 1994 I met with members of the Tu-144 team in Moscow, where they were converting one surviving Tu-144 into a flying laboratory.

The goal is nothing less than a new SST. A preliminary study by NASA's

High Speed Research Program estimates a demand for up to 1,000 next-generation SSTs by the year 2015. NASA would like those SSTs to be American, and in 1994 the agency started a \$1.5 billion, seven-year second phase of the program to develop technology for a Mach 2.4 aircraft that seats 300 and has a range of 5,000 miles. Aerospatiale, British Aerospace, and Deutsche Aerospace have established the rival European Supersonic Research Program to study a Mach 2 craft with capacity for 250 and a 5,500-mile range.

For critics of the SST, it's déjà vu all over again. In 1967 the Federal Aviation Administration predicted that by 1990 there would be a market for 500 copies of a proposed American SST. That airplane was to have been designed by Boeing, with the U.S. government funding initial development, but Congress squashed the program in 1971 after an \$800 million investment.

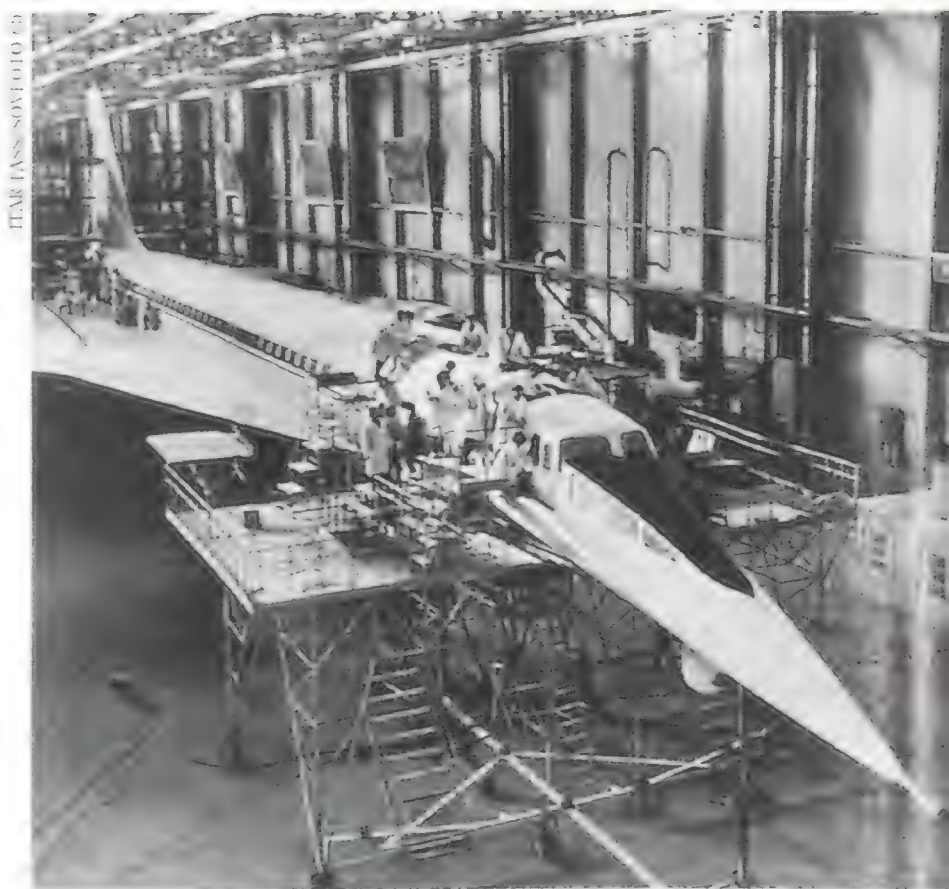
Also in 1967, British Aircraft Corporation's "most pessimistic" estimates showed a market for 200 Concorde by 1975; only 14 ever entered service. "Perhaps the most fascinating aspect of the SST theme overall is its cyclical return from the dead every few years," says

Howard Moon, author of the 1989 book *Soviet SST: The Technopolitics of the Tupolev 144*.

R.E.G. Davies, curator for air transport at the National Air and Space Museum, included the Concorde in his book *Fallacies and Fantasies of Air Transport History* because he believes that SST programs siphon money from more deserving projects. In a letter to *Aviation Week & Space Technology* last January he wrote, "The aircraft industry is promoting the SST myth, to generate many billions of dollars in development funds to be supplied by governments via taxpayers, very few of whom have ever flown or will fly in an SST. No more than a half-dozen city pairs ever could justify supersonic flights." (It's worth noting that the NASA study indicating the need for a next-generation SST was conducted by two airframe manufacturers who

hope to build it.)

The technical challenges are intimidating. SSTs need lightweight materials that can resist the high temperatures created by air friction. To reduce drag at cruise, they need wings with a thin airfoil, yet the wing's structure would have to be rugged enough to han-



Tupolev and Son

One of the great figures of Russian aviation, Andrei Nikolayevich Tupolev (left) was born in 1888 and made his first flight, in a glider, in 1909. He designed his first aircraft, a light sport monoplane called the ANT-1, in 1923, and during his life oversaw the design of 49 more prototype aircraft. In 1937 Stalin had Tupolev arrested on the trumped-up charge that he had been trying to sell blueprints to Germany. Sentenced to death, Tupolev was instead sent to the gulag, where he continued to design aircraft as part of a gulag design bureau. He was released in 1943.

After Tupolev died in 1972, his son Alexei became head of the Tupolev Design Bureau. Alexei, who had also been named chief designer of the Tu-144 project, "did not inherit his father's spark of genius," wrote Howard Moon in *Soviet SST*. Alexei was forced out of the company in 1992. He still lives in Moscow.



dle a hard landing. The engines must be powerful and durable enough for long periods at Mach 2 cruise, yet reasonably quiet, fuel-efficient, and environmentally sound: Of particular concern are nitrous oxide emissions, which may damage the high-altitude ozone layer. Such concerns helped kill the American SST program in the 1970s, leaving only the Concorde and the Tu-144 to duke it out.

Despite its technical shortcomings, the Tu-144 does offer one natural advantage for studying supersonic flight: It's very fast. In 1993, when Bill Adams, an affable Rockwell engineer, traveled to Russia to discuss ejection seats, a Boeing official asked him to look into the possibility of leasing a Tu-144. By April 1993 Adams and Rockwell had negotiated the lease of an aircraft from Tupolev. The program dovetailed nicely with American foreign policy and was even included as part of an agreement signed in Vancouver last June by vice president Al Gore and Russian prime minister Viktor Chernomyrdin.

But the practical realities of the program can be outlined more easily with an atlas than a flow chart. NASA's Langley Research Center in Hampton, Virginia, runs the High Speed Research Program, but the agency's Dryden center in California is in charge of the Tu-144 program. Boeing, based in Seattle, is the lead civilian contractor. Co-man-

A one-fifth scale model of the Tu-144 undergoes wind tunnel tests in 1967 (above). The production airplanes were assembled in Voronezh (opposite). A total of 17 Tu-144s, including two prototypes and three D models, were built.

ager McDonnell Douglas is in southern California, as is Rockwell, which is handling refurbishment of the aircraft and negotiations with Tupolev. Engine company General Electric is in Ohio, and Pratt & Whitney is in Connecticut. Tupolev is in Moscow; its business representatives are based in London.

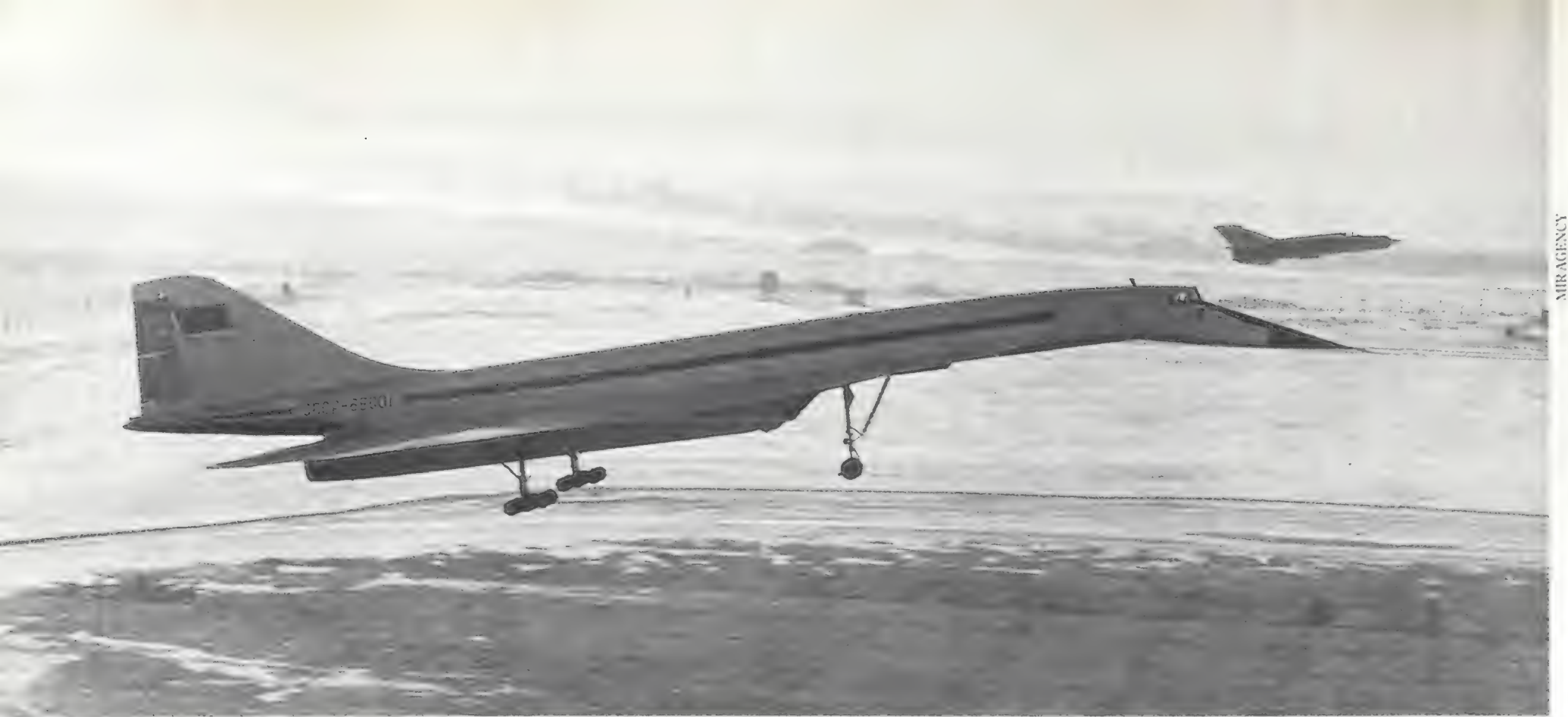
The Americans hope to measure the conditions of actual supersonic flight and compare them with the data that their computers and wind tunnels produce. "We've developed lots of predictions for the surface temperatures and the structural loads under these flight conditions," said Cal Jarvis, who headed the team from Dryden. "The question is whether they're correct.

"It was a big job to identify the experiments that everyone agreed were high-priority experiments," Jarvis continued. "We had 50 and screened them down to nine, which was kind of a traumatic experience." The seven in-flight and two ground experiments that made the cut will study surface, structure, and engine temperatures, sonic boom

signature, boundary layer, the wing's ground effect, aircraft handling, noise (interior and exterior), and the way the structure flexes in flight. (The sonic boom experiment was later dropped.) A total of 33 test flights are scheduled, all to be flown over Russia.

The aircraft selected for the project bears tail number 77114. "We looked at the list of Tu-144s that were built and this was in the best flying condition," said Jarvis. "This was the last one built, and most of the systems had been recently operated." The aircraft is one of the D models, which were equipped with Koliesov engines, an improvement over the original NK-144s. Still, 77114 is being upgraded with NK-321 augmented-turbofan engines, originally produced for the Tupolev Tu-160 Blackjack bomber, pushing the Tu-144 from Mach 2.15 to 2.3. The aircraft will be fitted with a new digital data system to replace the old analog one, plus thermocouples, pressure sensors, and skin friction gauges to measure the boundary layer. This meeting in Moscow was intended to nail down the final details of the experiments and schedule.

Although the cost of the program has crept from \$9 million to \$14 million, the Tu-144 project is still relatively small potatoes for the Americans and a small fraction of the \$440 million contract NASA awarded to Boeing and McDonnell Douglas for high-speed research. For



MIRAGENCY

Tu-144: A Steal?

To the Soviets, advanced technology was a state religion, and the Tu-144 was an important icon. Yet when it was first unveiled, it so resembled its Anglo-French counterpart that it was quickly dubbed "Koncordski."

"The SST concept was western in origin," author Howard Moon concedes, "but Soviet SST details were original, sometimes ingenious. This was a state prestige program; it would have been counterproductive to copy." That doesn't mean the Soviets didn't try to learn everything they could about their western rival. "All blueprints for the Concorde prototype were spirited

out of Toulouse, and the Soviets tried hard to abstract Concorde's engine management system from Lucas Aerospace before offering to buy it," Moon recalls. On one occasion Soviet agents collected Concorde tire fragments to study, but, Moon adds, "the French in turn fed Moscow's agents weird rubber compounds hitherto unknown to industrial chemistry."

Despite—or maybe because of—such chicanery, the production Tu-144s differed quite a bit from the prototype, with a different engine configuration, reshaped wing, and longer fuselage. The airplane also gained a folding canard for better handling at low speeds. (The later Tu-144D also had

The Tu-144 made its inaugural flight on December 31, 1968, chased by a MiG-21 that had been modified to analyze the aerodynamics of the SST's delta wings. On November 1, 1977, a Tu-144 flew to Alma-Ata, Kazakhstan, on its first passenger flight (opposite).

improved Koliesov engines, but the D model apparently never made commercial flights.)

The production aircraft was a better airplane, but with a range of only 2,000 miles it still wasn't good enough. In 1978, after only 102 passenger flights, Aeroflot quietly withdrew the Tu-144 from passenger service.

Tupolev, it's much more important. The loss of state support following the collapse of the Soviet Union has brought the Russian aviation industry to the brink of extinction. Forced to compete with western products, Russian companies like Tupolev are being overwhelmed: According to an April 1995 article in *Aviation Week & Space Technology*, 84 percent of Russia's aircraft companies are considered "financially insolvent." For Tupolev, the Tu-144 project is a chance to earn some hard currency. Russian pride is at stake as well. Tupolev, after all, had built an SST, something none of the American companies had ever done. Yet in 1991 Tupolev had to ask to be included in an international consortium formed a year earlier to study issues involved in a next-generation supersonic transport.

The meetings I attended took place at Tupolev headquarters, a grimy yel-

low-brick building in eastern Moscow that reflected the downtrodden state of Russian aerospace. The lobby was dim and empty, save for two grungy dogs. The lights were off in some hallways, forcing you to grope your way in the pitch dark.

Each day started with a meeting in a room called the Red Hall. Along its walls were large-scale cutaway models of various Tupolev aircraft, including a see-through Tu-144 detailed down to tiny suitcases stowed in the luggage racks and little newspapers on the tray tables. Following preliminary discussion, the meeting broke up into work groups, one for each experiment.

The surface temperature verification group went to work at a table in the center of the room, pinpointing the placement of their thermocouples. "We want specific locations as to each individual temperature measurement," explained

Peter F. Radloff, a soft-spoken McDonnell Douglas engineer, whose white hair and expansive mustache gave him a somewhat professorial air. One of the areas of concern is the wing-fuselage junction, an area that undergoes great thermal stress.

Bryan Johnson, a young Boeing engineer, later explained why exact placement is so important. "We need to know what is around that thermocouple so you know what might influence its response," he told me. "For instance, the fuel pumps: As the fuel runs through those lines they're going to get warmer."

"The same physical laws apply, whether you're socialist or capitalist," interjected Tupolev's Andrew I. Kandalov (he prefers to Anglicize "Andrei"), once a senior vice president and now retired, though his business card reads "assistant of the general manager."

On Wednesday afternoon the Amer-

icans were scheduled to visit the machine that had drawn them here. The Tu-144 was at Zhukovsky Airfield, site of its first flight and now an open air base. Beside the Bears, Backfires, and Blackjacks lined up on the ramp, a backup Tu-144 stood forlorn in the drizzle.

The program's Tu-144 was inside a hangar, where it was being prepared for modification. The Americans quickly ascended a boarding ladder and within moments were all over the airplane. Norman Princen, a young engineer from McDonnell Douglas in the ground handling group, headed into the cockpit to look at the instrumentation. Bryan Johnson and Craig Stephens of the surface temperature group went through the dark, stripped-out cabin and out an aft hatch onto the wing. There they peered inside the aircraft structure where the outside paneling had been removed and, after consulting their unrolled blueprints, began discussing the placing of thermocouples. Bob Rackl, a Boeing engineer with the cabin noise group, studied the location of the airplane's windows and determined where he would place his equipment.

The visit was over quickly, and the group boarded a bus for a short drive to the test facility's headquarters. Once

inside, they sat around a long, green-covered table adjacent to the director's office and sipped sweet Russian coffee as each group gave its report. The Americans were careful to praise the Russians, but there was an undercurrent of frustration over how little time they had had with the aircraft. Bob Rackl raised the topic gently, asking, "Would it be possible to slow the rotation of the Earth to give us more time?"

Back on the bus, some of the frustrations surfaced. Boeing's Bryan Johnson said that ideally they would have had an entire day to go over the Tu-144. "Access has been difficult," he said. When I mentioned that it appeared the discussions had narrowed down to details, he pointed out that in the United States it would have reached this point after a few phone calls and faxes. "They cooperate when it's easy," Johnson said, then, perhaps realizing that he was talking to a reporter, added, "Not to make that sound bad—normally you wouldn't get 300 thermocouples on an aircraft." On the other hand, he said, the SR-71 Blackbird had 400 thermocouples concentrated around the engines alone during its testing. Yet this Tu-144 is not a test prototype. "This is a production airplane, so all the stuff you give yourself

in a test airplane isn't there," he said.

On Thursday morning the American team gathered in the hotel for a quick strategy meeting. Frank Neumann, the brisk, no-nonsense Boeing engineer in charge of the delegation, led a discussion about the final statements each group would have to prepare. After some talk he ended the discussion by saying, "We don't have enough money to diddle around with this forever."

During the bus ride to Tupolev I talked with Norman Princen. "One of my main concerns is the number of pilots qualified to fly the aircraft," he said. "It was rumored that there was only one flight crew available." But chief of flight operations Sergei P. Avakimov had assured him that at least three pilots were available for the various maneuvers. Good news, Princen said.

This was Princen's second visit to Moscow for the Tupolev project, and he was still excited by it. "You read *Jane's* in high school about all these exotic aircraft," he said, "but you never dream that you'll participate in a project involving one of them." (On Friday he would work that thought into a toast.)

Later in the day, Alexander L. Poukhov, Tupolev's chief constructor, held a meeting in his small, cluttered office with



COURTESY VON HARDESTY



TOM HUNTINGTON (2)

Frank Neumann and Robert E. Patton, also from Boeing. Poukhov peered over the top of his glasses at a draft document of the meeting agreement, occasionally striking through a line with one of the sparkly Boeing pens that Bob Patton had been giving out. "This document is okay for us," Poukhov announced. "I crossed out places of misunderstanding from yesterday."

Then Poukhov began a presentation, illustrating his talk with a stack of 25-year-old charts of the Tu-144 wing geometry. He sorted out the ones he needed and hung them on a nail. At first Neumann and Patton seemed confused by the point he was making as he put up charts showing the Tu-144's wing aeroelasticity. Eventually it dawned on Neumann that Poukhov wanted the Americans to fund an experiment to more precisely measure the wing's geometry at various stages of flight.

As Neumann and Patton quietly conferred about this development, Poukhov sat across from me and talked about the program. He told me that Tupolev

Boeing's Frank Neumann and Rockwell's Warren Beaulieu (at left) study the Tu-144's wing structure while McDonnell Douglas' Craig Stephens (far right) discusses thermocouple placement with the Russians.

still has dreams of building a next-generation SST, the Tu-244. "This work we do not stop at any time," he said. He gave me a photograph of a Tu-244 model, which, except for its logo, looked like the Boeing and McDonnell Douglas versions.

As the groups continued to fine-tune their experiments, the managers gathered in Vyacheslav Alexandrovich Sablev's office. Sablev was a Tupolev engineer who was working with the in-

strumentation group; he also had what must be one of the largest offices in the building. For Tupolev this meeting was important because it would establish when they get paid. For the Americans, it would let them know exactly where the project stands.

Helping to guide Tupolev through the brave new world of capitalism is The IBP Group, run by American-born Judith de Paul. With her straight, jet-black hair and elaborate makeup, de Paul brings a touch of showbiz to the program. A former opera singer and television producer, she had started her career as a dancing matchbook in an Old Gold cigarette ad. As Tupolev's business advisor, she has been a combination of babysitter, negotiator, cheerleader, and spin doctor. She also provided the translators, most notably the three Sergeis. Little Sergei, young and balding, had large glasses that gave him the air of an inquisitive owl. Middle Sergei was outgoing and sardonic, sporting horn rims and a stylish haircut. Big Sergei was a stolid, no-nonsense Russian.

With Big Sergei translating, Poukhov announced that the first subsonic flight had been delayed until February 15, 1996. He discussed the test aircraft's new engines, four new ones leased from the military and two re-conditioned ones purchased from the Samara plant.

When discussion turned to payments, Rockwell's Warren Beaulieu, a big, beefy American, questioned the new schedule. "The milestones have slipped but the payment schedule hasn't," he complained. As the discussion continued, the people around the table rose and began jabbing fingers at the schedule.

At the closing toast, the Russians had the advantage of experience. (Rockwell's Bill Adams is in the center; IBP's Judith de Paul and George Kieffer to his right; NASA's Neil Matheny and Cal Jarvis at far left; Tupolev's Alexander Poukhov at right.)



Beaulieu didn't want to pay until Tupolev delivered its final report. "Let's say money will be paid as soon as you receive the report," Sergei offered. Adams and Beaulieu from Rockwell wanted a date. Sergei offered June. Judith de Paul stepped in to broker an agreement for May. "You'll have the report done by then," she assured Tatiyana Bubnova, the project's program manager. "*Khorosho*," said Poukhov. *Very good*.

"*Khorosho*," said Bill Adams.

"We have an additional volume of work related to the experiments," said Sergei. "We're talking about \$700,000."

"No, we're talking about \$400,000 for seven experiments," Neumann snapped. "We're here to tell you that the United States government and industry have agreed to \$300,000 for the sonic boom experiments and \$100,000 to TsAGI [the Central Aerohydrodynamics Institute]." Neumann won the round.

Finally Tupolev's accountant, V.V. Andreev, arrived to demonstrate to the Americans that Tupolev has an adequate system in place to track the work being done. A quiet, balding man with a mustache and a dark green corduroy

suit, Andreev was evidence that the concept of "accountant" translates freely across the cultural divide. He pulled out his ledgers and explained how work is tracked at Tupolev. Before he could finish, Poukhov rose and insisted that it was time to adjourn to the Red Hall and wind up the day's activities. De Paul protested that Adams needed to hear Andreev out, but Poukhov was insistent. Later, Adams pronounced himself satisfied.

Friday was the final day of meetings, and it ended with a reception that would include much toasting with vodka. The final reception at the previous meeting had already become legend, especially the toasting prowess of Poukhov, who managed to get through vodka toasts to all the companies, then every individual member of the American delegation.

The Russian toasting tradition was one of those cultural divides the Amer-


icans had difficulty crossing. NASA's Neil Matheny told me about one of his first visits, when lunch devolved into a series of vodka toasts. "I asked Judith if we could slow down on the toasts next time," Matheny related. "I got razzed a bit for that, but the next time there was no vodka on the table at lunch." Afterward, though, one of the Russians left to get some.

Following the signing of the final agreements in Sablev's office, the delegation adjourned to Red Hall, where the long conference table, now covered with a white tablecloth, groaned beneath trays of meats and vegetables, along with bottles of vodka, Armenian cognac, wine, and water. Toasting began with champagne, with Big Sergei translating. "Please charge your glasses!" he announced. "We expect rapid response from the American side!"

As the pace of toasting began to accelerate, the late afternoon sun broke through the clouds, shining through the gaps in the curtains and transforming the small room so that the crystal glasses on the table seemed to turn into clusters of diamonds. —

As an American delegation examined it in October 1993, the program's SST appeared to promise a rich future.





AN AMERICAN PILOT IN A P-47 THUNDERBOLT
DISAPPEARED ON CHRISTMAS EVE, 1944.
A HALF-CENTURY LATER, QUESTIONS ABOUT
HIS FATE MAY FINALLY BE ANSWERED.

by Stephan Wilkinson *Illustrations by Web Bryant*

HOMECOMING

Manfred Klein and Peter Drespa had already recovered pieces from the crashes of a B-17 Flying Fortress, a B-26 Marauder, two Lancasters, and a Messerschmitt Bf 109 when they unearthed what would be their most unsettling discovery. Young men in the German army with both a soldier's and a collector's interest in weapons, the two spend most of their weekends searching with metal detectors for the remnants of World War II that still litter the pastures and woodlots near their homes in western Germany. In June 1993 Klein persuaded a distant relative to allow them to search her cow pasture in a tiny hamlet outside Prüm, a town near the Belgian border. Klein had heard that an airplane crashed there during the winter battle for the Ardennes—the Battle of the Bulge—49 years earlier.

As Klein and Drespa criss-crossed the broad, open meadow amid grazing cows, their metal detectors chattered, signalling a hot spot just about in the middle of the field. They began to dig, eventually pulling from the ground several Browning M-2 .50-caliber machine guns, the barrels twisted and encrusted with earth. They later determined the guns had armed a Republic P-47 Thunderbolt. Klein had expected to uncover pieces of a fighter lost in the Battle of the Bulge. What he didn't expect to uncover was a grave.

"When I find the pieces of the parachute, I know the pilot is still in there," Klein says in halting English. "Then I find the bones. From the leg, the ribs, the pieces of the back—how you call it, the spine?—and the jaw." Klein and Drespa had uncovered the remains of one of the 78,000 U.S. military personnel still missing from World War II.

Local police halted the excavation. Almost a year later Adrian Tollzman, the civilian director of the U.S. Army Mortuary Service in Germany, got wind of the find. On August 8, 1994, Tollzman and a small crew went to Prüm.

"Two, three times a year it happens," says Tollzman, a gruff, bearish, sad-eyed mortician who has been stationed in Germany for 30 years. Most of the time, his laboratory in Frankfurt deals with the aftermath of Army helicopter crashes, car accidents, drug overdoses, murderous bar fights, or heart attacks, but several times a year, it gets called to an unmarked battleground. "The first thing you have to do," Tollzman says, "is iden-



P-47 Thunderbolt

tify whether the remains are human or animal, which can be a problem at a crash site. I've been told by Germans that if there was a hole in the ground—a crater—farmers would throw all sorts of garbage into it and eventually fill it in."

Tollzman and a small crew first dug by hand, then called in a backhoe operator. "He was terrific," Tollzman remembers. "He scooped out a little each time, and we raked it carefully. But he was concerned about unexploded bombs—afraid of hitting one with his blade. I told him I didn't know whether there were any or not, but I hoped the Lord was on our side."

The Army Mortuary Service in Frankfurt deals with the remains of U.S. personnel found anywhere in a vast area triangulated by England, North Africa, and Scandinavia. Their task is to disinter, clean, pack, and ship the remains to the U.S. Army Central Identification Laboratory in Hawaii. More than a year after Tollzman sent the remains to the lab, and as this magazine is being printed, the U.S. Army has yet to forensically, irrefutably identify the contents of the shipment, even though it included a mandible containing several teeth, which, when compared to military dental records, will almost certainly ensure identification. Yet the comparison will merely confirm what was already known nine days after Tollzman had exhumed the remains, for there can be no question about the identity of the P-47 pilot whose bones were found in that pasture outside Prüm.

In the colossal bureaucracy of the U.S. Army, under which the Army Air Forces operated in World War II, every thing had a number, and every action was accompanied by a re-

port, usually a form on which the numbers were entered in the appropriate blanks. One such form is a Missing Air Crew Report, which the Army required 48 hours after the last sighting of an aircraft and which lists the serial numbers of the crewman, airplane, engine, and installed weapons, as well as the circumstances of the disappearance.

The U.S. Air Force Historical Research Center at Maxwell Air Force Base in Montgomery, Alabama, has on microfilm every Missing Air Crew Report filed between May 1943 and September 1945. James H. Kitchens III, a slow-talking, gentle, articulate civilian archivist, has referred to the collection "as many as 100 times" in the 10 years he has worked at the center. So when a civilian mortuary specialist at the U.S. Total Army Personnel Command in Arlington, Virginia, called on August 17 last year asking for help in identifying an aircraft, Kitchens knew where to look. He can locate a specific report by the date it was filed, the serial number of the aircraft, or the serial numbers of the aircraft's guns.

"Somebody back then must have realized that guns would survive almost any crash, and that they would be the means to any future identification of aircraft or crew," he says. "You can have a smoking hole, the guns can be all bent to hell, but the serial numbers would survive. And since armament was tightly controlled and rigorously accounted for at the unit level, if you had those numbers, there could be no doubt about which aircraft they were mounted aboard or who was flying it."

Browning M-2 .50-caliber guns, numbers 1045512, 1045520, 1045534... Tollzman had called TAPC with the numbers from six machine guns, and within minutes, Kitchens had pulled



The heaviest single-seat fighter in the U.S. arsenal when it was introduced, the P-47 was famous for its ability to survive battle damage. At the end of 1943, Republic replaced the greenhouse canopy with a bubble to improve the pilot's rearward vision.

down a microfilm of Missing Air Crew Report #11442, filed on December 26, 1944, with the Commanding General, Ninth Air Force, APO 696, U.S. Army. It is a report of the last sighting of First Lieutenant Roger T. Lane.

According to the report, Roger Lane was on a dive bombing mission from Le Culot, Belgium, to St. Vith. It was Christmas Eve. The report includes a statement from a Second Lieutenant Ray Carter that his flight mate had been attacked. "At 1225, Hamlet Blue Flight, of which Lt. Lane was a member, was bounced by six Fw 190s," Carter wrote. "We were near Vielsalm, [Belgium] at 10,000 feet. Blue Leader and I, flying Blue 2, broke right with our bombs still on. Up until then Blue 3 and Blue 4 were in formation and alright. An Fw 190 passed below me on the right side and was firing steadily. That is the last I saw of Blue 3 (Lt. Lane)."

"It was a very emotional experience for me at the time," Kitchens says in the visitors' library of the research center, its somber walls decorated with paintings of aces and aircraft. "I am a bureaucrat, but at the same time I believe these matters are extraordinarily important. Regardless of Roger Lane's length of time in service, the number of his missions or victories, his decorations or lack of them, he had lain missing for half a century. And through all that time, his family had no way of knowing anything other than the fact that he had gone missing. Nothing."

"I feel there are few circumstances in life that could possibly be sadder," he says and pauses, struggling to control his voice, "sadder for a family than not to know...." But he can't continue. Jim Kitchens has never lost a loved one in combat, never had a relative missing in action, and has no personal connection to the case of Roger Lane, but tears stream down his cheeks. At another table a researcher with major's leaves on his shoulders glances toward us. My eyes burn as well, and I know if I look at Kitchens again, I will also cry.

Roger True Lane, a 22-year-old bookkeeper and stenographer from Portland, Maine, was assigned to the 36th Fighter Group, 53rd Fighter Squadron. They called P-47s fighters, but the airplane Roger Lane flew was then the world's strongest and deadliest single-engine bomber. It was a ma-

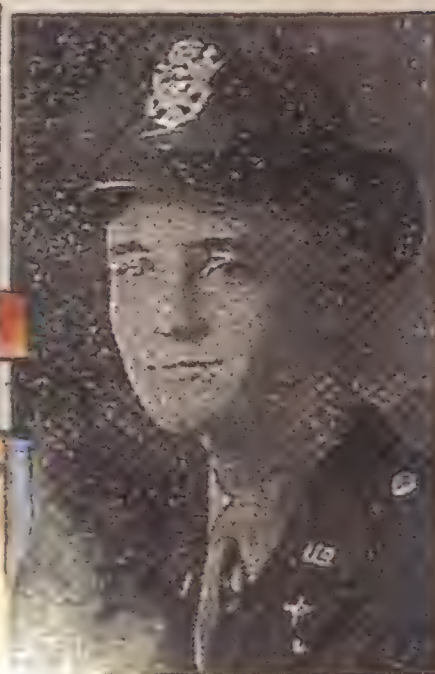
Lt. Roger T. Lane, P-47 Pilot, Is Missing In Action Over France

First Lt. Roger True Lane, AAF, pilot of a P-47 Thunderbolt fighter, who holds the Presidential Citation, the Air Medal with three Oak Leaf Clusters and the European Operations Theater Ribbon with three battle stars, has been missing in action over France since Dec. 24, the War Department has notified his parents, Mr. and Mrs. Beecher T. Lane of 61 Woodlawn Avenue.

Lieutenant Lane wrote his parents in a letter dated Dec. 22 that he and other members of the 36th Fighter Group, stationed in Belgium, were alerted two or three days before expected to go out on an emergency mission the following day. The mission from which he failed to return.

His father was notified at Belle Air, P.O. Box 100, Pocahontas, Mo.

Lieutenant Lane received his wings at Tuskegee Army Airfield, Okla., in December, 1943. He was then assigned to the 36th Fighter Group, stationed in Belgium, where he flew a mission over an enemy position in that country. He was last seen in his fighter.



Lt. Roger T. Lane



chine assigned to dangerous, treetop ground support rather than glamorous dogfights in the stratosphere. "What the ground support pilot accomplished in terms of total score—men and equipment destroyed—was way superior to anything that a fighter pilot did," says Tom Glenn, a squadron mate of Lane's. "As a fighter pilot, you were actually fighting the other machine. You never saw the pilot. In ground support work, when you're flying 20 feet off the ground and hitting infantrymen with eight .50-caliber guns, this...makes it very obvious to you that war is a very messy sonofabitch of a business."

The fighter-bomber pilots of the 53rd Fighter Squadron were anxious to fly that Christmas Eve. German panzer divisions had advanced deep into Belgium,

and the pilots wanted to get into the fight that would break Germany's rottweiler grip on U.S. infantry trapped in Bastogne. Besides, it was a beautiful day to fly. For a week they had been grounded by fog so thick it crept through the cracks of Nissen hut doors, soaked the tents where pilots slept, and hoarfrosted everything in sight, from the wings of the fighter-bombers to the spruce boughs of the Ardennes Forest. On December 24, the sun had seared away the overcast all over Belgium and western Germany. The air over the Ardennes was cold—fat with lift, dense with the oxygen that would flow through a Thunderbolt's turbocharger compressor.

Fighter-bomber pilots wouldn't have been expecting Luftwaffe fighters, which weren't a major threat to them in December 1944. Messerschmitts and Focke-Wulfs were rare. Their fuel was disappearing, the factories that supplied parts and replacements were either rubble or struggling into underground shelters, and competent German pilots were a tiny club with little hope of new members.

"The Luftwaffe's orders were that fighters were to be used against bombers, to protect the cities. They didn't give a damn about protecting their ground troops," Glenn recalls. "I saw fighters maybe three times in 50 missions, got into a couple of dogfights of maybe 15 seconds each."

"The Luftwaffe used to try to scare us into dropping our bombs and drop tanks. We'd turn to engage, and then they'd be gone. They weren't interested in fighting us, though we sure wanted to go after them in a bad way. So eventually we were ordered that we couldn't jettison our bombs until we were actually being fired upon, since our mission was to help the ground troops, not get into dogfights. Once they realized we wouldn't fall for it anymore, they disappeared."

But not that day in December, that place over Belgium, that moment when a boy named Roger True Lane fed in right stick and a little rudder to follow the leader south toward St. Vith. Lane was flying three slot in Blue Flight, Hamlet Squadron—the third Thunderbolt in a finger-four formation, part of a group of 12 airplanes. It was his 34th mission.

Lane had named his airplane *Scrumptious Bette* after Bette Nelson, a girl from Pocatello, Idaho, whom he'd fallen for during flight training. *Bette* was a silver, bubble-canopied P-47D-28-RE, though some of Lane's squadron mates were still flying the older versions of the airplane with conventional greenhouse canopies. Lane had a new airplane because he'd brought home a flak-ruined P-47 from a mission just a month earlier.

Today Lane's flight mate Ray Carter is a retired lieutenant colonel living in Westfield, New York. What he remembers about Christmas Eve, 1944, is the sun, the sky, and the surprise. It was half past noon. "I was Blue Two," Carter says. "We flew north of the Bulge, into Germany, then turned south right around Malmédy. Now, if you were in an area where you were going to be bounced, you flew the formation wide apart, like the Eighth Air Force did, so that you had room to turn into any attacking aircraft. But we were Ninth Air Force—fighter-bombers, not bomber escort—and we'd found that formation not to be very maneuverable. To follow a road, you've got to wiggle-wag a little more, so we brought our fingertips closer together, and in more of a vee. The bad part is that's more vulnerable to enemy air attack from the rear, because you're a little too close to your wingman to maneuver independently."



That may have occurred to *Leutnant* Carl Resch, *Staffelfuehrer* (squadron leader) of the 15th Squadron of the 54th Luftwaffe Fighter Group. Resch, in his Focke-Wulf Fw 190A-8, had seen the Thunderbolts from a good 15 miles away and well below, their uncamoouflaged aluminum glinting in the clear winter air. He probably saw dozens of other formations that day, for the U.S. Army Air Forces had marshalled as many as 1,200 P-47s, virtually every fighter-bomber in Europe, to break the Bastogne chokehold.

Resch, we can assume, put the nose of his aircraft down. (Some of this is conjecture, some is based on Resch's written combat report. Resch himself was killed less than three weeks later, strafed to death by furious P-51 pilots after bellying his battered Focke-Wulf into a field.) The hiss and clang of his guns charging—four 20mm Mauser cannon in the wings, two Rheinmetall 13mm machine guns in the cowl—had vibrated the Focke-Wulf's airframe 15 minutes earlier, for Luftwaffe pilots had learned to lock and load right after takeoff. They were in the combat zone the instant the wheels were in the wells. By the time Resch had Roger Lane and his wingman, Shelton Brannen, in his sights, the green and gray Focke-Wulf was doing probably 400 mph downhill; Lane was driving to work at perhaps 280.

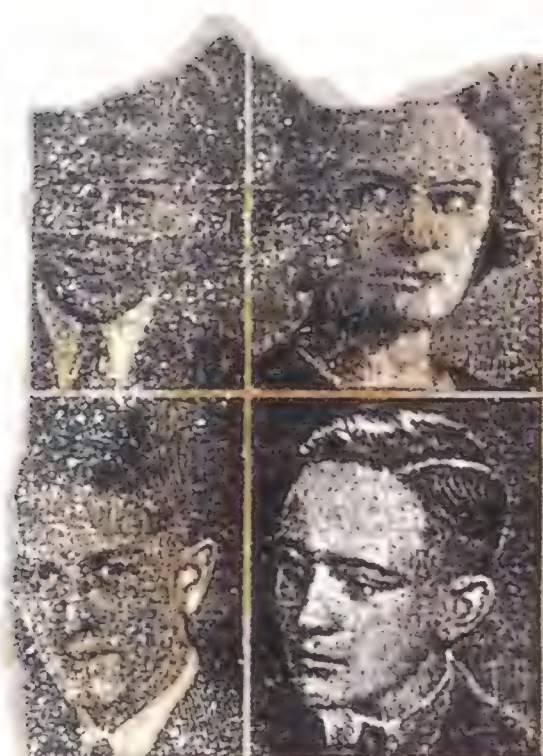
"As we started the turn to the south, I looked back for the element, and I saw them—Lane and Brannen," Carter remembers. "They were in fairly tight formation, in trail, not up with us. So I cut back on my throttle and stayed on the right wing of the flight leader, Al Reinhart. As soon as we completed the turn, I looked back for Lane and Brannen—

I'd lost them at about the 45 of the turn—and they were gone." That's when Carter saw the German fighters. (Shelton Brannen bailed out of his P-47 and survived the war in a German prison camp. He died in 1957.)

It is likely that neither Lane nor Brannen saw the wolfpack of seven Focke-Wulfs and Bf 109s until they were hit, because Ray Carter was the one who sounded the alert.

His call to Reinhart—"Okay, two bandits closing fast six o'clock, break right!"—was the first announcement that Carl Resch and 15/JG 54 were on their case. Carter and Reinhart racked their P-47s through 360 degrees to come around and tail-chase the two Focke-Wulfs, "but I looked back again and there's two more coming," Carter recalls. "We got on *their* tails, looked back, and two more came in—finally the last two. Reinhart and I each are on somebody's tail and there's nobody behind us. We didn't say a word,





MARION L.

Clubs: Debating
Activities: Orchestra

It's too bad all talent doesn't come double. With a dozen more doubles like this, we would put Hollywood out of business.

ROGER LANE

Clubs: Washington
Athletics: Track

In limitless energy, Roger is unexcelled. He proves beyond a doubt that the smallest of us are often the liveliest.

both went to full power and threw on water injection—oh yeah, you can see the smoke in the exhaust...steam, really—and I got one and he got the other.”

The disposition of the German fighters—*Staffelfuehrer* alone in the lead, three pairs of planes following like whip-pets on a rabbit—was less a formation than the result of one experienced pilot saying to six low-timers, “Just stick with me and do what I do.”

“Were those Germans inexperienced?” Carter mulls over my question. “Well, let’s just say I sure didn’t consider it a dogfight. They didn’t evade, they didn’t turn to engage. I got one hit just in front of the rudder, one on the vertical stabilizer, another about halfway up the fuselage, and another in the cockpit area. And boy, he just leveled off, the canopy came off and he went out the right side. Didn’t want to play at all. Fight’s over.”

Robert Candello, another of Lane’s squadron mates, was also flying that day, though on a mission in a different piece of Belgian sky. “That was my 11th mission,” Candello says, consulting a faded diary.

Candello can’t figure how Lane and Brannen got caught that day; he can only assume that they had become complacent. “I drove my car for half a year after I came home with my head on a swivel,” he says. “You got in the habit of looking around. The thing that bothers me is why Lane and Brannen stuck together so closely. They should have at least been far enough apart that the wingman could cover the leader. I hear the German guy claimed both planes. One pass to get two of ’em? That’s unusual as hell—especially P-47s.”

An eight-year-old boy named Peter Krump came upon the crater *Scrumptious Bette* had dug at the edge of a grove of spruce trees. He was ravenous and foraging for food. He still lives in Prüm, where he works today as an electrician.

“I did not see the crash,” Krump says, “but I was first at

the place. I knew it was an airplane, though it no longer looked like one. I was hungry, and I, how you say...gripped into the hole. In every hole we had learned to look for something to eat, because sometimes soldiers threw away food. So I looked to find tins, packages, chocolates, cigarettes—anything. I saw this,” Krump points at my belt, “and drew it out of the hole. But then I saw that my fingers were all bloody, and I ran away. For I knew now there was a dead man down there.”

Three days later, Krump got up his nerve and returned to the crater, but the wet earth had by then collapsed into it, interring First Lieutenant Roger True Lane, USAAF, in unconsecrated ground in his 22nd year.

Lane’s P-47 crashed in a part of western Germany that is in places moderately forested and hilly but that certainly is as well-trafficked and populous as exurban Connecticut or Marin County. Every square meter has been tramped by hikers, farmers,

engineers, tourists, and construction crews. Nor was the crash site hidden in a ravine or deep in a wooded glen. It was in the middle of a grassy meadow, less than a quarter of a mile from a busy road, visible from a mile away. How could the wreckage have stayed untouched and Lane undiscovered for so long? “As you can see, people are poor in this area, and I think that the few parts of the airplane that stayed near the surface were taken away after the war by people who could sell the metal,” says Peter Drespa. “The heavy parts, like the engine, the guns, the bombs, they have the energy to go down deep into the ground, and when an airplane hits the ground going that fast, there isn’t much else left.” Klein and Drespa’s metal detectors showed no evidence of bombs. In what may have been his last deliberate act, Lane almost certainly dropped his stores the instant he knew he’d been bounced.

“When we uncover a crash, people always ask us, ‘Okay, where is the airplane?’ But the airplane is...” Drespa makes a gentle “poof” sound.

It is late afternoon in May 1995, and I am standing with Drespa (who is not very much older than Lane was when he died) in the meadow where Lane was buried for 50 years. “There was a man in that hole who was doing his job. Okay, he was the enemy, but no more,” Drespa says. “It would be a lie for Manfred and me to say it is not interesting to find machine guns, but it is not good to see the people who care only about the metal things that remain. I am a soldier, a grenadier, and if I must go to somewhere like Yugoslavia and be killed, if I know someone comes to look for me, it makes it easier to go.”

Adrian Tollzman told me that the Army would send the remains home, once they are identified, accompanied by a full uniform and in a casket draped with an American flag. “I was in the Korean war,” Tollzman says, “and as a veteran

and a mortician, I know this is something that helps families deal with a loss. It's final, it's done, the thing is over with."

But to whom will Roger Lane's casket be sent? After 50 years, what family is left to deal with this loss?

When the U.S. Total Army Personnel Command in Virginia has been assured by the laboratory in Hawaii that an identification has been accomplished or is imminent, a mortuary specialist tries to locate the next of kin. He will frequently call Linda Abrams. Abrams, a deeply patriotic, 55-year-old veteran from Massachusetts, is the Army's sole next-of-kin specialist. The telephone call, she says, always opens with the same five words: "Linda, we need some help."

Abrams is a civilian volunteer whose hobby, genealogy, has honed her research skills. About five years ago, she tracked down the closest living relative of a Springfield, Massachusetts man after reading an ad the Army had placed asking for help in the veterans' newsletter *Stars and Stripes*. That turned out to be her first case.

In this case, TAPC provided her with the name of Roger Lane's father, Beecher, and the address, taken from the deceased personnel file, where the notification of his disappearance had been sent 50 years before. Lane's case was the most difficult Abrams has ever taken on. Lane's mother had died when he was six. No friend who had ever known his father was alive. And Beecher Lane was apparently the patriarch of a family that had chosen to remove itself from the affairs of the large Lane clan in Maine; no other Lanes knew of their existence. "I was ready to quit a couple of times," admits Abrams, "and it was the first time that had happened in over 200 of these cases that I've done." But in Lane's file she had found letters from his father to the Army, letters that continued into the 1950s asking for more information about his son's disappearance, pleading with the Army to ask members of his squadron what they could tell of the last days of Roger Lane. When Abrams learned through her initial research that after the war Beecher Lane had placed a headstone in the Yarmouth, Maine cemetery for his son, she became determined to find the one person who could ensure that Lane would be returned to Yarmouth.

The trail circuitously led to the husband of one of two half-sisters, who was able to give Abrams the name and address of Roger Lane's half-niece and sole surviving relative, Nancy Farbstein, a restaurant owner in Queens.

"I saw Beecher, an old man sitting up there in Maine after a war for which he'd paid such a terrible price, his wife gone, his only son gone, his two daughters out of touch," Abrams says, close to tears. "He so wanted his

boy to come home that he'd erected that headstone in the cemetery, ready for him. I wanted to bring Roger back for Beecher, and the only way I could do that would be find the kin who could make the decision to have him buried there rather than in some military cemetery, which is what the Army would have to have done. When I called Nancy Farbstein, I had to lose my objectivity and tell her that there was only one place to bring him—to Yarmouth." Linda Abrams' record is still unbroken. Not only did she find Roger Lane's niece, she located *Scrumptious Bette's* namesake, Bette Nelson, a 68-year-old resident of Santa Rosa, California, who met Lane when she was 16, went dancing with him every weekend before he left for the war, and wrote to him faithfully until a letter from one of his squadron mates informed her he was shot down.

The 36th Fighter Group Association held a memorial service for Roger Lane at its September reunion in Texas. The members placed a bronze plaque in Lane's honor in the General Jimmy Doolittle Memorial Gardens at the Confederate Air Force Headquarters in Midland. Tom Glenn, who organized the service, spoke recently about the group's experience during the war. "When Lane joined the outfit, he was a small guy—maybe five-nine and 145 pounds—but a very decent guy," Glenn recalls. "We took a liking to him."

Nobody in the group had talked about the circumstances of Lane's death, he remembers. "We had an unwritten rule: If anybody didn't come back from a mission, we just shut 'em out. Nobody ever mentioned their name again. That's all. What are you going to do? Go crazy? Your friends are getting killed on a weekly basis, and you've got to develop some mechanism to enable you to deal with it."

The photos of Glenn on the wall of his California study show a young pilot who was a dead ringer for Fred MacMurray. Fifty years later, Glenn is still a splen-

dently handsome man, with wavy snow-white hair, white eyebrows over blue-gray eyes, and a precise, wide, white mustache. It is as though the snow of that December in the Ardennes had returned to mark him forever.

"I still see Roger in my mind, the way he looked then," Glenn says with a gentle smile. "All the rest of us, Christ, we've got gray hair and wrinkles. We're old. But he's still young."

When the Army sends Lane's casket and flag to Yarmouth, Maine, Nancy Farbstein and Bette Nelson will be there to receive them. Then something of Roger Lane, apart from his physical remains, will have come home. —





ASTRONOMY'S

Scientists hankering
for an unimpeded
look at the cosmos
can start at the
bottom—of the
world, that is.

by Donald Goldsmith

Photographs by Ann Hawthorne

Just push the telescope around a little, will you?" Journalists aren't often asked to assist scientists, but when you're at the South Pole and one of the scientists has won the Nobel Prize, journalistic detachment seems a little foolish. The astronomer asking for help is Tony Stark, a chunky, bearded astronomy enthusiast (to put it mildly). His colleague is Bob Wilson, who won the Nobel for helping to discover the cosmic background radiation. The telescope they want me to help with is the newly arrived pride of Antarctic astronomy, the Antarctic Submillimeter Telescope/Remote Observatory. The first permanent

polar observatory for submillimeter-wave radiation, AST/RO has already met with near-catastrophe on its trip south.

It's January, summer in Antarctica, and the sun has been shining continuously for the past three months. The temperature outside has risen to -15 degrees Fahrenheit, but inside the "baby buggy" canvas that covers the AST/RO telescope, people work with relative ease in a windless environment, warmed by heat from the building below—and by their own infrared and submillimeter-wave radiation.

Despite the difficulties of working at the pole, astronomers are enthusiastic



HOT SPOT

about being here. What appeals to them about the pole is not the clear air, the six-month nighttime, or the fact that the celestial objects visible from here circle the skies at the same altitude above the horizon, never rising or falling. (The only exceptions are the closest celestial objects—the sun, moon, and planets.) Instead, the South Pole's value as an observatory arises almost entirely from the fact that it is nearly the driest place on Earth. Because atmospheric water vapor blocks nearly all infrared and submillimeter-wave radiation—from wavelengths of a few microns all the way to 1,000 microns (one millimeter)—only a few of these short

wavelengths can be studied with telescopes at mountaintop observatories. For those who observe in infrared and submillimeter wavelengths, going to the pole is like lifting a window blind to see the cosmos.

New arrivals at the South Pole find that the low humidity adds one more queasy feeling to the disorientation caused by the intense cold and the 9,300-foot altitude. (The brass pole that marks the southern extension of Earth's axis stands atop a nearly two-mile-thick layer of ice whose weight has depressed the underlying rock below sea level.) But it's that combination of low temperatures and high altitude—and the

A nice place to do space science, but would you want to live here? The South Pole's "dark sector," which is kept free of interfering radiation, is at left.

pole's location 800 miles from any significant body of water—that reduces atmospheric water vapor. At the pole, only on a dozen days per year does the water vapor in the air rise to the average level at the next-best established observing site, the 13,800-foot-high Mauna Kea Observatory on the island of Hawaii.

Three different astronomical instruments profit from the pole's dry air. In



The horn-like COBRA peers upward to study cosmic background radiation; behind it is the closed "baby buggy" that sits atop the Pomerantz Laboratory and protects AST/RO. At left, Tony Stark stands behind AST/RO's main dish.

addition to AST/RO, a project called COBRA (Cosmic Background Radiation Anisotropy) uses a giant horn antenna to study the cosmic background radiation, the relic of the early years of the expanding universe. COBRA looks for tiny deviations (anisotropies) from complete smoothness in the radiation. In 1992, the Cosmic Background Explorer satellite made the first observations of these deviations, which as-

tronomers use to explain how galaxies began to form. At the pole, observers are improving on measurements made by COBE, which had an angular resolution—an ability to see detail—only 10 times the width of the full moon. COBRA's angular resolution is several times finer, and the instrument has already found irregularities on smaller angular scales than COBE could detect.

The third large telescope at the pole

is the South Pole Infrared Experiment telescope. SPIREX resembles an optical telescope, but it detects infrared radiation at wavelengths close to 2.4 microns, about one one-hundredth (or less) of the wavelength of radiation AST/RO detects, though still much longer than the wavelengths of visible light (0.4 to 0.7 micron).

The activities of SPIREX, AST/RO, and COBRA are all coordinated from a site 8,500 miles away, at the University of Chicago's Center for Astrophysical Research in Antarctica. CARA was established by the National Science Foundation to support South Pole astronomy, and many a building, person, or project at the pole is referred to as "part of CARA, you know." In full summer season, dozens of e-mail messages pass back and forth each day between the people at the South Pole observatories and their collaborators in the Windy City.

AST/RO's tribulations exemplify some of the difficulties of doing scientific research at an isolated location. "We need a submillimeter telescope at the pole," Tony Stark explains. The instrument had to fit inside one of the C-130 Hercules cargo planes that supply the South Pole station and AST/RO "is the biggest that could come in one piece," Stark says. AST/RO has a 5.6-foot carbon-fiber reflector, which brings to a focus the short-wavelength radio waves that astronomers call submillimeter-wave radiation. Even at polar temperatures, all objects radiate some submillimeter-wave radiation, so AST/RO was designed to avoid picking up interference from its own detectors. In a conventional radio telescope, the detectors are directly in front of the collecting dish; AST/RO's "off-axis system" focuses radiation off to one side.

Stark and his team of astronomers and engineers built and tested AST/RO in Boston, then disassembled it for shipping, packed it all with extreme care into boxes within boxes, and then put the packages on a truck bound for California. There the telescope would catch a supply ship to New Zealand; from there the instrument was scheduled to take an eight-hour Hercules flight to McMurdo Station, at the edge of the Antarctic continent. An additional three-hour flight would deliver the telescope to the pole.

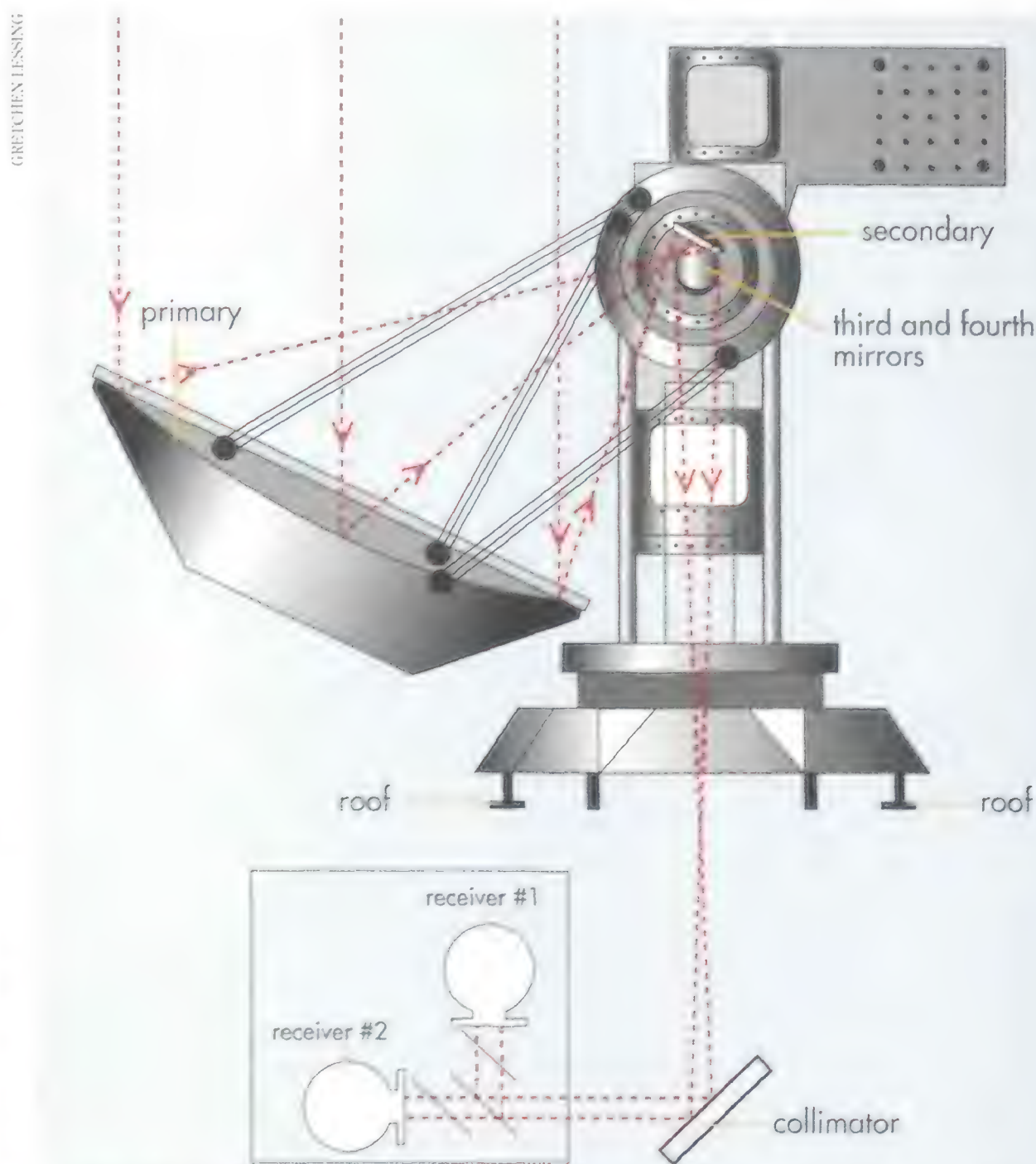
But the well-laid plans came crashing down one night on Interstate 40 in Little Rock, Arkansas, when the truck was rear-ended not far from one of President Clinton's favorite hamburger joints. "Not all the difficulties with Antarctic astronomy arise in Antarctica," Bob Wilson notes ruefully. The accident made AST/RO miss the boat, and after an inspection it had to be flown to New Zealand. Although the telescope's dish was undamaged, the accident affected the fine adjustment of the reflecting dish's mounting, which includes a hollow pipe made of quarter-inch steel through which the radiation focused by the dish passes on its way to sensitive detectors suspended beneath the instrument.

Because the mounting had been designed to require no attention once installed, access to its inner recesses was difficult: at the pole, Stark and his co-

workers would grunt frequently and ruefully as they checked the encoders that indicate how far the tube has turned, adjusted the bolts that can move the encoder assembly by a few thousandths of an inch in various directions, and made other tests to see how well the telescope's pointing accuracy had held up. They discovered that the accident had spoiled nearly every critical alignment made before shipment. By the end of December project scientists had finished much of the realignment; by mid-February, as summer ended at the pole, Stark felt reasonably confident that AST/RO's performance could meet its design specifications. Along with the

rest of the AST/RO team, he departed—as did the 120 other residents of "summer camp"—for warmer climes.

Left behind as one of the two dozen polar "winter-overs" was Richard Chamberlin, a tall, quiet postdoctoral fellow from Boston, who monitored the telescope's operations throughout the Antarctic fall and winter. Chamberlin braved temperatures averaging -80 to travel just over half a mile from the central dome of the Polar Station to the "dark sector," an area kept free of optical and radio wave interference, where the newly opened Pomerantz Laboratory offered him work space next to the AST/RO building. In (relatively) good weather,



AST/RO detects short wavelengths known as submillimeter radiation; to keep the instrument from recording its own emissions, the collection devices are set off-axis from the detectors. Four cryogenic receivers can be installed on the optical table beneath the telescope. A series of mirrors can be adjusted to direct the beam into two receivers simultaneously.

Chamberlin chose to walk rather than use one of the station's snowmobiles. "It's nice to be outside under the stars and the aurora," he said, although the trips to the telescope could be difficult. "With the darkness, lack of contrast, and iced-up goggles, the visibility is about like trying to scuba-dive in Boston's inner harbor," Chamberlin reported. "It's quite common to stumble in the sastrugi [deep ruts carved by the wind blowing through the snow], because you can't see them."

Another difficulty is the electrical supply. "The major problem we face right now," Chamberlin said in May, "is that the expanded operations here are often driving the generator plant beyond its capacity, and we often experience brown-outs and occasional black-outs. Fortunately, none of our sensitive electronics have been damaged by the power problems."

Ironically, one of Chamberlin's main housekeeping duties was to keep AST/RO cold. All objects at temperatures above

absolute zero (-471 degrees Fahrenheit) emit submillimeter-wave radiation, and even during the polar winter AST/RO's detectors would radiate enough to swamp the weak cosmic signals. The detectors therefore had to be cooled to three degrees above absolute zero with liquid helium. Because helium evaporates, Chamberlin had to replenish the supplies every week or so.

By May, Chamberlin had finished adjustments of AST/RO's pointing system and had the telescope working nearly up to its design standards, which included the ability to be guided remotely (as implied by the second half of its name) via the Internet. There are no phone lines to Antarctica, and because communications satellites orbit almost exactly on the horizon as seen from the

SPIREX may resemble an ordinary optical telescope, but it observes infrared radiation rather than visible light.

pole, Internet communications are typically available only a few hours per day—crucial hours for the isolated winter-overs, who save up their outgoing messages for those times and greedily devour incoming news. "Fortunately, we have a pretty good Internet link," Chamberlin said, "so I try to farm out some of the data reduction work to the students in Boston. The link also allows Maohai Huang, our programmer in Boston, to maintain the system and even to run a debugger on the software/hardware system that runs the telescope if we have to." Someday, observations may become completely automated, guided by astronomers from a warm office back in the States. For now, as Tony Stark remarked, "it's more reliable—and cheaper—to pay an ambitious and intelligent young scientist."

With the telescope finally in running trim, the AST/RO astronomers have two immediate projects: to survey the galaxy in the submillimeter-wave emission from cosmic carbon atoms, and to study Earth's stratosphere by observing the emission from carbon monoxide and ozone molecules. The first project should eventually yield valuable information about conditions at the edges of clouds of gas and dust in interstellar space, where stars are believed to form. The second will help to monitor the changing conditions in our planet's upper atmosphere. "Studying the emission from carbon atoms will take us most of the next two seasons," Stark estimated. Observing carbon atom emission will not be easy, because even absorption from the dry polar air interferes with the signals. The absorption is caused by carbon monoxide molecules as well as the tiny amount of water vapor in the air, and part of the AST/RO effort is to measure the absorption precisely.

As the AST/RO telescope was adjusted, the SPIREX infrared telescope also underwent major changes. SPIREX was built by a team of astronomers and engineers under the direction of Mark Hereld, a lanky, prematurely graying physicist-turned-astrophysicist who earned his Ph.D. in experimental physics from the California Institute of Technology. An expert at building experimental equipment, he had a chance to show his abilities when his team con-





From deep within the Antarctic ice, AMANDA's detectors (above) will search for neutrinos. On the rare occasion when a neutrino strikes an atom in the ice, it creates a muon (right). The muon creates a detectable cone of Cherenkov radiation; the direction it travels indicates the direction from which the parent neutrino arrived. The detectors will pick up very weak signals, which will be amplified by a factor of a hundred million.

structed SPIREX's specialized infrared detectors. Last January, following a week of careful preparation, Hereld and his team watched a crane hoist the SPIREX telescope onto a new mounting on a specially built platform of the Pomerantz Laboratory. "That actually went pretty smoothly," Hereld noted, "unlike a lot of what happens down here." Now positioned far from any interfering heat, SPIREX should soon begin a survey of the infrared sky. "We've still got some engineering humps to get over," Hereld reported in March, "and then we'll start to survey in earnest. We're going to pick some representa-

tive areas of the sky and study them in depth to compare them with what optical telescopes reveal."

Even from its previous temporary mounting position atop the AST/RO building, SPIREX made news in August 1994 when it studied the impacts of Comet Shoemaker Levy-9 with Jupiter. Working from the depths of Antarctic winter, with Jupiter only a few degrees above the horizon, the SPIREX observers were able to follow the impact sequence 24 hours a night—important data for the astronomers studying how the 3,000- to 6,500-foot-wide cometary chunks affected the giant planet.

Whereas the infrared, submillimeter, and cosmic background telescopes exploit the pole's dry air, AMANDA, the Antarctic Muon and Neutrino Detection Array, takes advantage of the ice. By far Antarctica's largest astronomical project, at least in area, AMANDA looks for neutrinos, chargeless particles that arise in the hearts of cosmic violence—for example, the cores of exploding stars. Neutrinos react very little with matter, and because they reach us almost unaffected by anything between their source and ourselves, they may contain crucial information about, for instance, why and how some stars explode. But their unwillingness to interact with matter makes neutrinos notoriously difficult to detect.

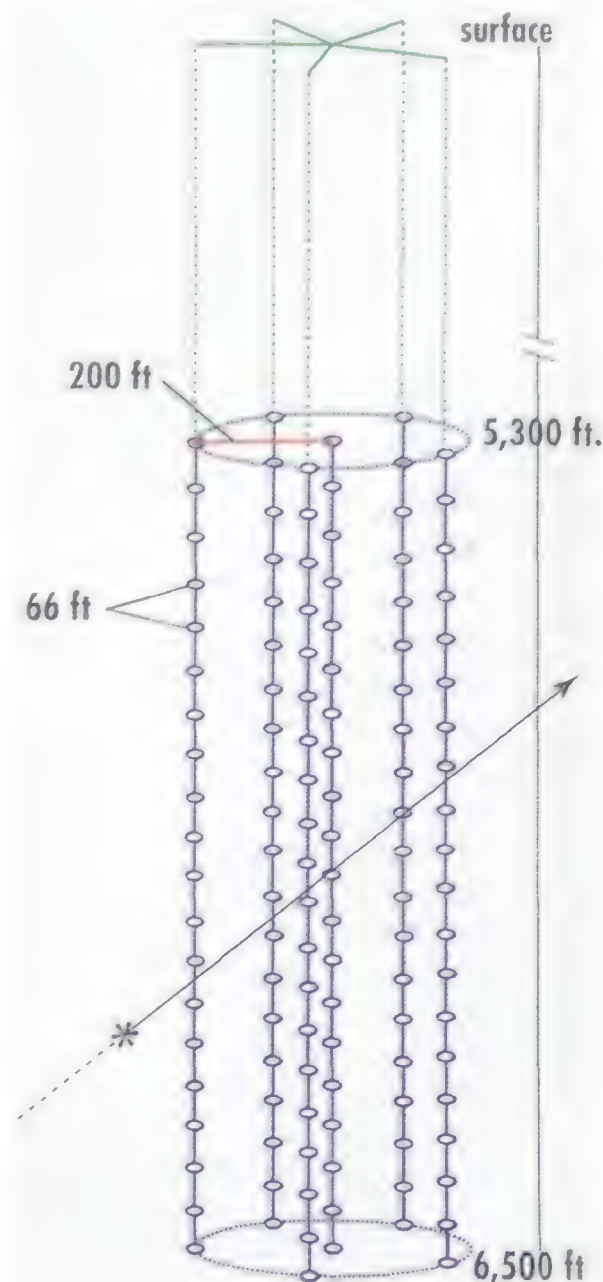
AMANDA's detectors will be suspended inside a dozen holes, each drilled 1.4 miles deep, nearly to the bottom of the polar ice cap. With all its detectors in place, AMANDA will use a cubic mile of ice as a target for the elusive neutrinos. When neutrinos pass through the ice, a tiny fraction of them will, on occasion, hit one of the nuclei in the ice to produce a muon, and AMANDA's instruments will detect radiation from these muons, the fingerprint of neutrino impact.

Interestingly enough, AMANDA will actually "look" all the way through Earth for its neutrinos, using the planet as a filter to screen out muons created when cosmic rays strike the atmosphere. The planet can't screen out all the atmospheric muons, but AMANDA's scientists will look for steady "hot spots" that indicate neutrinos from a cosmic, rather than atmospheric, source.

If AMANDA succeeds, it will be be-

cause it embraces such a large volume of ice. A sister project, DUMAND (Deep Underwater Muon and Neutrino Detector), aims to use a few cubic miles of the Pacific Ocean off Hawaii for a similar detector. But the scientists on that project have had great difficulties building instruments that can withstand mile-deep ocean pressures. In contrast, AMANDA must "merely" find ways to drill 6,500-foot ice holes. (As originally planned, AMANDA's detectors would have been up to 3,300 feet deep, but tiny air bubbles in the ice at that depth created too much interference.) During the 1993-94 summer, the AMANDA team drilled test holes using hot water (which allowed the first hot-tub baths at the South Pole). The test borings showed that the plan for AMANDA is feasible, and the 1995-1996 summer season should see significant progress, although the actual system will not begin operating until 1998.

Not all Antarctic astronomy happens





at the South Pole. Eight hundred and fifty miles to the north (there are no other directions) lies McMurdo Station, by far the largest “city” on a continent twice the size of the 48 states. During the four summer months (November through February), McMurdo’s population swells from a winter figure of 120 to 1,200. That includes more than a hundred U.S. Navy personnel, who operate all the helicopters and fixed-wing aircraft—a duty that the Navy wants to turn over to other agencies. Another hundred or so are scientists, mainly biologists who study the rich marine life, and about half are the support staff, employed by Antarctic Support Associates (ASA), a private firm under contract to the NSF.

Astronomy at McMurdo Station employs giant balloons that circle the globe (not as long a trip as it would be nearer the equator) carrying instrument packages that detect high-energy gamma rays as well as cosmic rays—fast-moving electrons and nuclei. Launching the balloons

McMurdo Station (above) lies some 850 miles from the pole. The flags below surround a symbolic South Pole; the marker for the true geographic pole, in the back, is moved annually to compensate for ice drift.

takes finesse, since high winds can spoil the process, and recovering the instrument packages, which are released on radio command, takes even more: Some have been lost when they fell into the frigid sea.

In the next few years even more astronomy will be conducted in Antarctica, provided that the NSF can main-

tain its funding, which now stands at a bit under \$200 million annually for the entire Antarctic program. The 1995-96 summer at the South Pole will see new receivers for the SPIREX telescope, the continuation of COBRA studies of cosmic background radiation, drilling for the AMANDA neutrino detectors, and half a dozen smaller projects to study cosmic rays and the upper atmosphere. In five years, the South Pole station should be one of the world’s leading observatories.

According to John Bally, an astronomer at the University of Colorado who leads a team that is planning more-advanced instruments for the South Pole telescopes, “In the same way that astronomers discovered the advantages of Mauna Kea during the 1960s, they’re now finding out how good the South Pole is—much better than Mauna Kea for nearly all infrared and submillimeter observations. Ten years from now, I hope we’ll look back and wonder how astronomers managed without an observatory at the pole.” ➔



THE SMITHSONIAN TRAVELER

• TO REQUEST TOUR AND SEMINAR BROCHURES, CALL (202) 357-4700.
• OR WRITE TO
STUDY TOURS & SEMINARS,
MRC 702, WASHINGTON, DC 20560.



Call or write for your FREE Smithsonian Study Tours & Seminars catalogs, featuring more than 300 tours to 250 exciting destinations in the U.S. and abroad!

INTERNATIONAL TOURS

City Interludes November 1995-November 1996: Extended stays in some of the world's great cities: London, Paris, Venice, Florence, Hong Kong, Kyoto, Vienna, Berlin, Prague, Istanbul, St. Petersburg, and Hamilton (Bermuda).

Countryside Tours February-October 1996: Relaxing sojourns in France, England, Scotland, Wales, Austria, Switzerland, Italy, Hungary, the Czech Republic, and Mexico.

NEW Panama and Costa Rica January 2-12: Aboard the *Polaris*.

U.S. AND CANADA TOURS

Smithsonian "Anytime" Weekend (Washington, D.C.) New value package of \$198, double occupancy, includes free parking.

NEW Gardens and Steamboats (New Orleans to San Francisco) April 3-8: On the *American Queen*.

SMITHSONIAN SEMINARS

NEW War in the Pacific (Honolulu, Hawaii) February 7-11. →

NEW Civil War: Chickamauga and Chattanooga (Tennessee) April 18-21.

ODYSSEY TOURS

Moderately-priced Tours (1996) Great Britain, Italy, Sicily-Malta, Greece, Greece-Crete-Santorini-Rhodes-Turkey, France, Jordan-Israel, Egypt, Morocco-Portugal-Spain, Munich-Prague-Budapest-Vienna-Salzburg, Belize-Honduras-Guatemala, Costa Rica, Peru, Rio de Janeiro-Buenos Aires-Montevideo-Santiago, Australia-New Zealand-Tasmania, U.S. National Parks and Washington, D.C. For an Odyssey brochure, call 1-800-932-8257.

THE LATEST WORD ON TOURS AND
LEARNING ADVENTURES

Take the Caravan I.Q. Test and win.

We gave it the works, including a great prize.

It couldn't be easier to qualify to win the Caravan I.Q. Sweepstakes because we've already given you the answers. See, we really did think of everything.

Win Microsoft's Flight Simulator
game software
Courtesy of AIR&SPACE

Test your I.Q. by taking this short quiz. Don't worry, the answers are in the Dodge Caravan Chapter 6 insert you just read.

1. What makes the new Caravan so quiet?

- a) sheets of sound-deadening mastic b) a foam panel in the roof
c) strategically placed visco-elastic material d) all of the above.

2. Wind noise is reduced by -

- a) Caravan's sleek new shape b) extra sealing in the doors
c) a very aerodynamic side mirror d) all of the above.

3. The new Dodge Caravan offers carpeting that -

- a) is backed by three layers of sound insulation
b) will inspire you to write poetry
c) matches your Aunt Eunice's sofa
d) don't you wish all tests were this easy?

4. If you can think of anything else you'd like to know, you can call 1-800-

NAME _____

ADDRESS _____

CITY _____

STATE _____

ZIP _____

Official Rules:

(1) No purchase necessary. One entry per licensed driver, 18 years or older. Void where prohibited. (2) To enter, completely fill out the entry blank or print your name, address, daytime telephone number, quiz answers and "Caravan I.Q. Sweepstakes" on a 4"x5" card and send it to Air & Space/Smithsonian, Dept. I.Q., 901 D Street, SW, Washington, D.C. 20024, to be received no later than December 15, 1995. (3) Drawing to be held on December 20, 1995. Illegible, late, lost, postage due, damaged and facsimile entries will not be considered. Winners will be notified by mail within five days after the drawing date. (4) Ten winners will each be awarded one copy of Microsoft's Flight Simulator game software. Federal, state and local taxes are the sole responsibility of the winners. No substitution or transfer of prizes. (5) Employees (and their immediate families) of Air & Space/Smithsonian, Chrysler Corporation, Chrysler Corporation product dealers, and their advertising, public relations, and merchandising agencies are not eligible. (6) Odds of winning depend on number of eligible entries received. The decision of Air & Space in all matters relating to the rules and administration of the sweepstakes shall be final. The winners shall be required to execute an affidavit of eligibility/prize acceptance and release and consent to use of his/her name and/or likeness in advertising without further compensation, unless prohibited by law. Noncompliance will result in disqualification and the selection of an alternate winner. (7) Winners' names can be obtained by sending a self-addressed, stamped envelope to: Air & Space/Smithsonian Magazine, Dept. I.Q., 901 D Street, SW, Washington, D.C. 20024.



The New Dodge Caravan
Just as original as the original.™

by Henry Scammell

Photographs by Geoffrey Clifford

On a Saturday afternoon in late May 1993, I flew north from Ho Chi Minh City—the former Saigon—to Hanoi on a Vietnam Airlines Tupolev 134B-3. A Soviet-built mid-range jetliner, the airplane had a proletarian blue and white exterior, but the cabin hinted of something different. Hand carved, darkly varnished cabinets in the forward bulkhead and circular portholes beside the seats created the illusion of an Art Deco sky-going yacht. It would have been the perfect setting for

the opening scene in a remake of *Lost Horizon*, updated to jet but retaining an austere, 1930s panache.

That brief echo from one of the great survival classics was the first clue to what lay just ahead. A twice-recycled boarding pass directed me to Seat 1A. In the Tupolev, all four positions in the first row allow a scant five inches between the seat and the polished wall. This was going to be a problem.

The cabin was stifling. When at long last all the passengers were seated and



PASSAGE TO VIETNAM

the boarding ladder had been rolled away, the air conditioning system erupted. Billows of frosty air blew down diagonally from spigots in the ceiling and crisscrossed in the aisle. In moments the windows were opaque and the walls ran with condensed moisture. Shangri-la had vanished in the vapor.

But the flight attendants were beautiful, dressed in powder blue skirts, stylized neckties, and impeccably white blouses. It was a minor matter that not one of them knew a word of English,

or that when a friendly translator in the next seat asked about the type of airplane, they told him they didn't know. All the smoking and seatbelt signs, at least, were in Vietnamese and English; until a few months before, the second language had been Russian. One of the smiling attendants emerged from the mist with Saigon Coke. It tasted like the old soft drink Moxie.

Ten minutes into the flight, the vapor dispersed, the porthole cleared, and far below the airplane, smoke from

Soviet Tu-134s dominate the Vietnam Airlines fleet at Noi Bai Airport in Hanoi. Soon the airport will receive U.S. airlines for the first time since 1964.

farms and factories rose up to join the general haze. To the left, the mountains drifted off toward Cambodia in folds of green and purple velvet. Here and there, patches of more brilliant green suggested rainforest, and one imagined tigers. The landscape was so vast and



LONG BEFORE THE UNITED STATES NORMALIZED DIPLOMATIC RELATIONS WITH ITS OLD ENEMY, U.S. AIRLINES HAD BEEN CLEARING THE PATHWAY.

serene it was hard to reconcile it with the labor that took place there building and traversing the Ho Chi Minh Trail. From 25,000 feet there were no signs of the war, nothing to connect this land to remembered images of the long-ago struggle, the noise, the suffering, the terrible assault on the earth that made a moonscape of the DMZ. Now it all appeared to be washed over with new growth and salved by the haze of heat and altitude and time.

The Tupolev flew over the long barrier beaches north of Hue, where the river waters flowing down from the Annam Cordillera are filtered in the tidal marshes before they mix with the South China Sea. Then the shore bends inward toward the west, nearing the narrowest section of this hourglass country, and the jetliner headed out over the Tonkin Gulf.

I visited Hanoi two and a half years ago to observe discussions between Viet-

Vietnam's new interest in a market economy is reflected by advertising in Ho Chi Minh City's main square.

Site of a fierce stand by U.S. marines, the hills of Khe Sanh today produce choi dot, a plant exported for brooms.



nam Airlines and Continental, one of several U.S. airlines then exploring business opportunities with the Vietnamese flag carrier. Even before President Clinton lifted the trade embargo in February 1994, Continental, Northwest, Delta, United, and American had all sent representatives to Vietnam, each hoping to share with VNA the traffic that would be possible between the two countries once diplomatic relations were normalized. Which of the U.S. carriers will prevail, however, depends not only on VNA's preference but on a tangle of bureaucratic procedures.

First, the number of routes available must be determined by negotiations between the Vietnamese aviation authority and the U.S. departments of state and transportation. Once that number has been announced, the airlines will file applications with the DOT, and the department will either make a ruling or send the case to an administrative law judge for a recommendation. The process is long and complicated, but so is the establishment of a business relationship with a state-owned institution in a communist country. So the American executives started laying the groundwork for cooperation in 1992, and they found through the course of their negotiations that both sides had a lot to learn.

"In many ways, this job is déjà vu from my early days in Eastern Europe," Joe Basso told me when I met him in Hanoi. At the time Basso was Continental Airlines' general manager for the Philippines; he holds the position today with Continental Micronesia, a subsidiary of Continental operating in the Pacific. Basso spent 27 years with Pan Am, 18 of them behind the Iron Curtain, doing pretty much what he was doing in Hanoi—negotiating contracts—while serving as station man-

ager or country manager in Poland, Czechoslovakia, Hungary, Rumania, and the Soviet Union. "The spirit of the people is the same," Basso continued, "except the Vietnamese figured out that the system doesn't work 50 years sooner than the Soviets did, so they invented market socialism and started looking again toward the West."

This was Basso's sixth visit to Hanoi in 12 months. He was part of Continental's point team in its complex and, for many months, secret courtship of Vietnam Airlines. The team was trying to nail down agreements for exchanging passengers: Travelers

flying Continental to Manila and wanting to continue to Vietnam would be potential customers for VNA; passengers flying to the U.S. west coast and wanting to connect to other cities were potential customers for Continental. Continental's executives were also interested in selling expertise and training to the Vietnamese and perhaps in obtaining financial interests in the airline. The point team's assignment was to establish trust and to gain intelligence that would determine the possible extent to which Continental could

As Vietnam looks toward the West, its Soviet Tu-134s will gradually be replaced by U.S. and European craft.

Russian was once Vietnam's second language; now escort vehicles at airports beckon visitors in English.

become involved with VNA.

"I look at these trips as my last great adventure," said Basso.

The driver steered the gray sedan across a long, otherwise empty iron bridge, the first of two crossing the wide river between Noi Bai Airport and downtown Hanoi. In the marshland and rice paddies at the southern end of the bridge, two parallel rows of round, brackish ponds marked the lethal path of the carpet bombings from 20 years before. "These will probably never go away," Basso said. "Hanoi wasn't bombed, but you see these craters near bridges, rail lines, and former military sites all around the edges of the city."

I also saw among the ponds, rising only slightly above the tall grass, the numerous stone monuments to those the bombings killed: soldiers, farmers, passersby. The number of Vietnamese officially reported killed in the war is 3 million, 50 times higher than the 58,000 lost by the United States. "Don't look too long," Basso said quietly, nodding toward the driver. "If he sees you're interested, he'll tell you America did this.





Philippine Air Lines has been flying to Vietnam since 1985 and sharing passengers with VNA since 1987.

During the trade embargo, U.S. products, like the brand names in this Hanoi market stall (above right), found their way to Vietnam via third-country middlemen.



I get it almost every trip."

The car passed an oxcart plodding toward the city with an enormous load of rubber tires. Below the road embankment, a water buffalo luxuriated in the neck-deep red-clay waters of another crater outside an immense brick factory. "If you know anyone who thinks the U.S. sanctions don't reduce the effectiveness of a nation, they should come here; it's set them back decades," Basso commented. "However, if I were betting on which of the former communist countries would emerge from the ashes first, my money would be on the Czechs and Vietnamese."

Vietnam Airlines headquarters were located in a modest low-rise office complex a short distance outside Hanoi, at the end of a rutted, muddy, partially macadamized street lined with vendors' stalls and shanties. The airline's buildings sat at the edge of farmland.

Basso and colleague Vincent Nguyen, a Vietnamese-American in Continental's legal department, were met in the lobby by their counterparts from VNA. One appeared to be in his 20s; the other two could have been in their late 30s or early 40s.

In choosing interline partners, VNA

will be considering, among other things, which carriers can offer the best "split," the biggest share of the price of a ticket between the two countries, and who can provide the best and cheapest training and assistance in upgrading services, which VNA desperately needs to compete in an international market. Basso and Nguyen were there to discuss those things and to lay the groundwork for a visit to Hanoi by the top tier of Continental's management.

The VNA team was friendly but formal in the way of businessmen anxious to get to the purpose of their meeting. The group wound its way to a conference room in an appendix to the main building. The windows were covered by white lace curtains made in a factory in East Germany that once supplied identical drapes to every meeting and office room in the communist world. The group took seats at a horseshoe-shaped table with a red velvet cloth covered by four-foot slabs of quarter-inch tempered glass.

For much of the post-war era, state-owned and -operated Vietnam Airlines was run by war heroes who adhered to the business model of the Soviet Aeroflot and who, along with the rest of the country, were held in the economic thrall of the Soviet Union. They created a service that was primarily domestic but reached out to a

few international destinations like Phnom Penh and then, seven years ago, Manila, using old Soviet equipment that was growing obsolete as fast as the system that produced it.

In 1986 the government's communist leadership proclaimed a new policy of market socialism, a hybrid system with one-party communist rule and an economy based on free market principles like competition. The country then began slowly and confusedly pulling itself in that direction. Today, the organization of Vietnam Airlines is still based on communist central planning,

but many of the airline's middle management jobs and even some at the top are held by the fresh faces of a professional class open to practices of the West. At the time of my visit, a deputy director general of VNA, Nguyen Duc

Vinh, whose paramilitary title is equivalent to an executive vice president at Continental, was 27 years old. Director of corporate affairs Nguyen Ngoc Quang was in his 30s. He told Basso on an earlier visit, "We're starting at zero. Everything we do is going to be new."

He and others his age at VNA had been out talking to civil aviation people in different countries and were developing an international bank of experience. "They've started operating Western-style aircraft on both dry lease and wet lease," said Basso. Dry lease is just





the airplane; wet comes with cockpit/cabin crew and ground support. In either case the aircraft do not wear VNA livery but are painted white.

Air France took the lead in such deals. In September 1993 the airline wet-leased two Airbus A320 aircraft to VNA. In the first year VNA paid Air France crews to operate the aircraft

and train VNA employees. In the second year VNA crews flew on their own. Through this arrangement VNA gained experience with Western airliner operations, a necessity if the airline is to compete for customers on international routes. And Airbus gained vast goodwill in a market in which Boeing and McDonnell Douglas now appear to be disadvantaged.

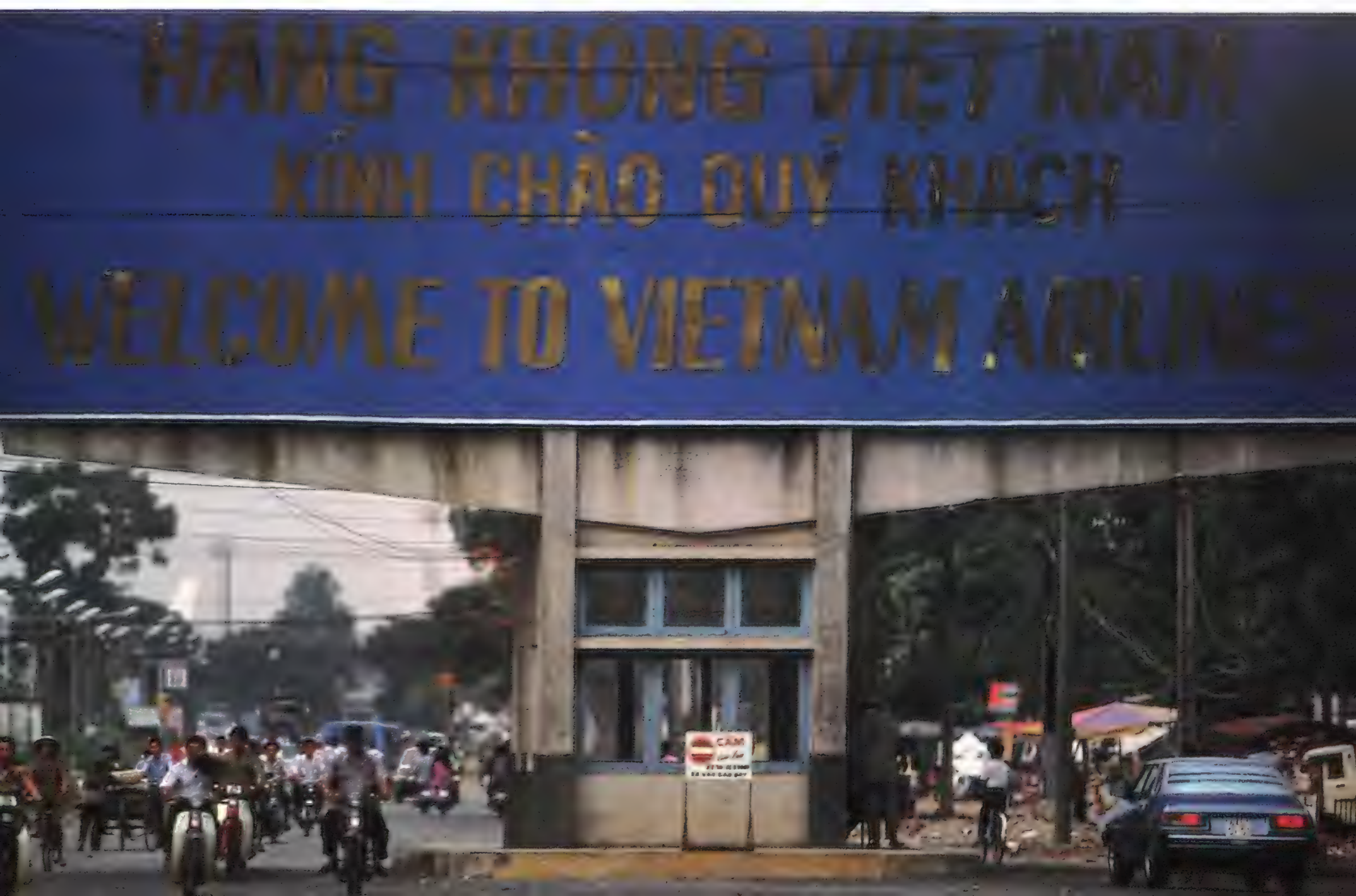
VNA was also getting training in reservations and information management systems from Air France, as well as from Philippine Air Lines and other European and Asian carriers. "You can see each time that they're more and more sophisticated," Basso said. "From a year ago to now is like night and day. They're putting the data together very quickly and making decisions right at the table that they wouldn't have even considered a year ago. They're learning how to determine profitability."

VNA's inexperience with Western business philosophies and practices complicated the negotiations with Continental. In the summer of 1992, when the Continental team first asked for statistics so they could formulate a proposal, they were told, "We don't have statistics. All of this is just too new. Can you help by showing us what data we should be gathering and how we formulate it to make it work for us?"

In January 1993, Continental and Vietnam Airlines developed a joint marketing plan, which provided the frame-

work for most of the subsequent negotiations through the meetings I observed. Continental's marketing study estimated 1,520 daily seats to Ho Chi Minh City from Bangkok, Hong Kong, Kuala Lumpur, Singapore, Taipei, and Manila, and another 420 seats to Hanoi (exclusive of arrivals from China). Continental figured 80 percent of those passengers were coming from the United States, and it wanted to route as many as possible through its existing service from West Coast cities through Guam to Manila. Likewise, VNA wanted to attract passengers for the last leg of the flight, where they compete with Philippine Air Lines. Joining forces could help

Among the first sights at Hanoi's Noi Bai Airport are the military-style caps of the customs officers (opposite). Ho Chi Minh City's Tan Son Nhut Airport is Vietnam's largest. Between 1990 and 1992, passenger traffic there doubled. VNA anticipates further increases.





U.S. airlines will be playing catch-up with the many international carriers already flying to Hanoi.

both airlines, who face competition from the Asian carriers already flying from L.A. and from other U.S. carriers. When the embargo was lifted in 1994, United Airlines, which had acquired authority to fly to Vietnam by purchasing Pan Am's Pacific routes in 1986, quickly announced its intention to fly from Los Angeles to Ho Chi Minh City.

Most of the customers that the airlines are targeting are the 800,000 Vietnamese who have immigrated to the United States. Continental, believing that these travelers will prefer to fly on their native country's flag carrier, proposed that Continental and VNA jointly operate ticketing facilities in the six major Vietnamese communities in the United States.

"But also part of the equation now are the 8 million Vietnam veterans," Joe Basso said recently. "Significantly a number of them have been traveling back already, and we think that that is probably almost as interesting a market as the American Vietnamese."

Vincent Nguyen conducted the meeting in English. It was first agreed that top Continental management would visit Vietnam in July and that VNA representatives would visit Houston in the fall. The conversation moved quickly to customs and immigrations proce-

dures. In order to ensure on-time connections, each airline must know how long it takes the other to complete such tasks. VNA had had little experience with international ground handling and was looking for information. For entry to the United States, the Vietnamese asked, could the processing be done at Guam? Honolulu? Los Angeles? Basso said it could be done in Guam and that the whole affair takes about 35 minutes for 200 passengers. The VNA negotiator looked perplexed—probably because processing travelers took longer in his experience—but said nothing. Basso invited him to Manila to see how it was done.

The electrical power in the conference room was extremely unsteady, with lights continually dimming and brightening and the air conditioner alternately dropping to a whisper and rising to a roar. Over time, the effect intruded on the psyche, as though the utilities in the room were wired to the energy level of the negotiations.

They turned to a discussion of fares for refugee traffic. Every year Vietnamese and Amerasians (Vietnamese with one American parent, probably a

former soldier, who are outcasts in the culture) immigrate to the United States to join family members. Last year 44,000 traveled on a number of airlines, primarily Continental and Northwest. The International Red Cross and a U.N.-affiliated group, the International Organization for Migration, fund the travel and work with the government of Vietnam to determine the annual number of migrants. The Vietnamese negotia-

tor specified the share of the money his airline expected to receive and cited agreements that he said had been reached with United and Northwest.

Basso realized that Continental's interests would be

ill-served if his company entered a bidding war over this issue, and he said, "You're attempting to develop a relationship with Continental. Your agreements with other carriers are irrelevant." Nothing was said by way of rejoinder, but the body language at the Vietnamese end of the table suggested the perplexity had deepened.

It was agreed that in July Continental's visiting executives would meet with the Vietnamese ministers of trade and tourism, transportation, and other agen-





More than twenty years after the U.S. withdrawal, signs of the war remain: near Hanoi, a B-52 crash site is a reminder of U.S. bombing. Opposite: The Vietnamese lost 3 million people. They are still moving bodies from isolated graves to cemeteries.

cies. Nguyen discussed ways to get the visitors to schedule more time in Hanoi, with a side trip to Halong Bay, a spectacular coastal site in the north that was ripe for development and eventual tourism. The discussion moved to labor costs for pilots and mechanics, then to in-flight food service.

The next day's meeting started off with Nguyen saying that Houston has instructed him to apologize for the "misunderstanding" about the division of refugee air fares discussed the day before. His counterpart smiled with obvious relief. There was enthusiastic discussion about hiring two helicopters to fly to Halong Bay, which would split Continental's key managers up for safety reasons. Plans were made for a three-hour boat ride. The session was off to a good start.

Just outside the lace-curtained window, an old man in a bamboo hat slowly crossed and recrossed the small field, cutting the 18-inch grass, which looked more like a crop than a lawn. After it was cut, he bound the stems into sheaves and severed them at the base with short, choppy swings of a sickle-shaped knife.

In 1992, Vietnam Airlines and the Ministry of Transport and Communications contributed to a Civil Aviation Master Plan for the Socialist Republic of Vietnam from 1993 to 2001. They had guidance from the United Nations Development Project and the International Civil Aviation Organization (whose joint offices are located a few blocks from the old prison known to the Vietnamese as the Oven and to U.S. POWs as the Hanoi Hilton). Internationally, Vietnam is served by only three airports: Tan Son Nhut

Airport for Ho Chi Minh City, Noi Bai Airport for Hanoi, and Da Nang Airport on the central coast, below the old DMZ. Combined international volume at those airports in 1992 (the last full year of the UNDP/ICAO study) was over a million passengers, and the master plan projects the annual growth rate to continue at 10 percent through the year 2000.

Many consider those projections to be conservative. In the three years of the UNDP/ICAO survey, 1990 through 1992, annual passenger traffic in and out of the biggest airport, at Ho Chi Minh City, more than doubled, with the greater portion of that growth in the international sector. VNA has positioned itself to gain a share of the expected increase in international travel by striking deals for reciprocal landing rights

with roughly 20 foreign carriers flying to Vietnam.

The United States is the airline's largest potential overseas market. The Vietnamese have very strong ethnic ties to their country, and many of them want to come home every year to celebrate the Tet holiday and the lunar new year. But because of the embargo, the Vietnamese could not seek partnerships with U.S. airlines. It was up to U.S. airlines to come to them. Delta was the first.

In 1992 Delta sponsored a 10-day tour of the United States for a delegation of the top people from Vietnam Airlines—ex-fighter pilots, war heroes. They went to Disneyland, Delta's offices in Atlanta, and the Boeing factory in Seattle.

On the whole, the trip was regarded as a success, but it wasn't without some miscues and colorful sidelights. When the Vietnamese delegation toured the Museum of Flight in Seattle, a docent, apparently confused about which side he was dealing with, lingered at the museum's Skyraider dive bomber and praised its famous versatility in combat. The docent, a former Navy pilot, said, "I guess I don't need to tell you what a great ground support airplane this is. You saw what it could do during the war."

One of the American hosts immediately cut in to advise the docent, quietly and matter-of-factly, that these Vietnamese had been in the north, not the

Continental's 1993 marketing agreement proposed extending its existing flights to Manila into Vietnam.





Crowds gather atop the new departure lounge at Noi Bai Airport to watch the activity, which grows every year.

A street vendor's goods in Ho Chi Minh City offer tacit commentary on U.S. exports (below).

south. The docent smiled and said by way of apology, "Gosh, I really put my foot in it." The visitors smiled back. No one remarked on the incident at the time, but both sides saw the small moment for what it was, a graceful sign of the healing that had taken place since the war ended.

Once Delta started these cultural exchanges, the other carriers got interested, partly because word traveled through the grapevine of Pan Am alumni. Almost all of the major U.S. players in the reopening of Vietnam are former employees of Pan American, which dominated the Pacific for 50 years before selling its operations there to United Airlines in 1986. Former United chairman Stephen Wolf is a Pan Am graduate. Delta's first emissary to VNA had been a Pan Am sales manager in Hong Kong. And many of the executives who were representing Continental in the Pacific at the time had Pan Am experience. Paul Casey, who was Continental's vice president for international marketing, was the former Pan Am sales manager for the Pacific division. Keith Braden, Basso's boss at Continental, was the Pan Am country manager for Taiwan, and Basso himself had been Pan Am's manager in the Philippines. "Those of us who are still out here so-

cialize together all the time," Basso said. "We all thought: Why let Delta walk in? Why not at least give them a run for the money?" David Grizzle, a Continental vice president, graduated from Harvard College and Law School rather than from Pan Am, but he saw the same potential in the emerging market and organized Continental's first exploratory probe to Vietnam in 1992.

Airline industry analyst Mort Beyer says Continental was battling the odds. "The Department of Transportation usually operates by the rule 'To them that have shall be given,'" he says. "The carriers that have the greater financial strength, bigger fleets, are likely to pick up the traffic. Northwest has a very strong presence in the Pacific. United bought Pan Am's old routes and has had a fairly significant learning curve. Only because of the notorious proclivity of DOT to favor the big carriers, these airlines are more likely to get the routes."

In May 1993, Continental obviously thought it had a fighting chance. On the final day of the team's sixth visit, Joe Basso had already returned to Manila and Vincent Nguyen went alone to the familiar conference room. In the course of the afternoon the power dropped: the air conditioner ran at a



low hum, and the bulbs in the chandelier had gone out. The room was somber, almost autumnal in a land that has no seasons. A Vietnamese negotiator, not yet out of his 20s, quietly discussed fare structures and destinations with Nguyen, entering numbers on his battery-operated computer.

And that's the way it ended. Despite the fact that a tremendous number of items had been agreed to and many plans made, the film of the meetings unwound on an amber-toned, slow-motion scene with no clear conclusion. There was the usual exchange of hand-

shakes and weary smiles all round. The home team took its leave in the lobby, and Nguyen headed back to the airport for the trip south.

In the two years since then, Basso has continued talks with VNA but as a representative of Continental Micronesia and with the goal of cooperating in VNA's regional service as much as in the transpacific market. Basso says that the courtship of VNA is not as in-

tense as it once was. When I imagine U.S. and Vietnamese bureaucrats sitting around a velvet-covered conference table and slogging through the broad agenda of affairs of state, I wonder if the air routes between the countries will be decided in this century.





At Da Nang Airport, a MiG-21 fighter taxis behind a European ATR-72 that VNA uses on domestic routes.

While I was leaving Vietnam in 1993 from Tan Son Nhut Airport in Ho Chi Minh City, a jaunty fighter trainer in duck-blind camouflage, perhaps a Mirage, clean as a whistle and looking deceptively toy-like, rolled briskly by the waiting room window. On the line was a Boeing 767, wet-leased from the Australian company Ansett Worldwide Aviation Services and painted white, another form of camouflage for a different kind of war. Beyond that were the concrete and steel vaults built to protect the American fighter jets of an earlier era, now mostly empty but a few housing huge, ungainly, battleship gray Soviet helicopters—the Hook heavy transport, and Hip and Hound transport/assault aircraft—that looked as though they were never designed to fly.

On the waiting room TV, Ed McMahon was hosting a magic show from Hollywood. Viewers scattered lackadaisically about the lounge, mostly American tourists and businessmen and Americanized Vietnamese, drank cans of 7-Up, bottled in Ho Chi Minh City. In this tableau, Vietnam appeared as an archaeological cross-section with all its layers visible, each revealing something different about the past, and all alive at once. There were clues there, probably enough for an oracle capable of reading them all, to solve the entire mystery of the country's future. —

Billboards are springing up near airports in Vietnam. The English may be awkward, but the message is clear.



For details on Song Be Golf Resort, contact Palm Song Be Golf Company, Thuan Giao Commune, Thuan An District, Song Be Province, Vietnam. Tel 960170 Fax 960173

Ho Chi Minh City office Telephone 655036/658154/653456 Extension 201 Fax 84 8 655333



COMMENTARY:

Goodbye Yellow Brick Road

Commercial airline pilots know how to get from Los Angeles International Airport to Chicago-O'Hare: They follow the Yellow Brick Road.

The aerial highway between L.A. and Chicago has something in common with the convoluted path in *The Wizard of Oz*. At first, the route runs relatively straight through California and Nevada. But then it slants sharply northeastward through Utah and into Wyoming to avoid traffic outbound from Denver. After a hard right turn, it winds through South Dakota, Iowa, and southern Wisconsin before descending toward always-busy O'Hare.

Along the way, controllers in air traffic centers act as traffic cops. Communicating via radio, they direct the pilots to maintain certain speeds, altitudes, and safe distances from other aircraft.

For almost 60 years, we've depended on air traffic control to keep airplanes safely out of one another's way. The system works but it could be more efficient. Pilots have little flexibility to change their flight plans to take maximum advantage of shifting winds or weather conditions. As more and more airplanes fill the skies, the operating restrictions cause delays that cost airlines and their passengers an estimated \$3 billion a year.

But the days of the Yellow Brick Road in U.S. airspace are probably numbered. Spurred by a convergence of satellites, computers, and digital communications technology, the Federal Aviation Administration and aviation users are crafting a revolution in air traffic management: a concept called "free flight."

In its ultimate form, free flight would



ALAN E. CORBER

let pilots fly whatever route makes sense under the existing conditions. One day, it could mean taking a direct route to minimize trip time. On the following day, pilots might fly a different path to dodge weather or turbulence and give passengers the smoothest possible ride.

Controllers would continue to play a vital role in air traffic management. Pilots would still have to file flight plans, which could be modified by air traffic control if they posed any safety hazards. Controllers would receive altitude, speed, position, and heading data automatically from aircraft in flight. But they would intervene only if computers predict that an aircraft's "alert zone"—

a chunk of airspace shaped like a hockey puck—would violate the same zone around another airplane.

The benefits of free flight go straight to aviation's bottom line. American Airlines, for example, has calculated that a reduction of just two minutes per flight would save the carrier \$40 million annually. United Air Lines says full implementation of free flight could cut its yearly operating costs by \$600 million to \$1 billion, with another \$800 million in increased productivity savings.

The concept has such enormous promise that the FAA is committed to implementing it as quickly as possible. But I want to stress that there are two fundamental principles we are following. The first is maintaining the safety of an airspace system that is already the world's safest and most efficient. Safety has always been uppermost in our minds at the FAA, and it will remain the ultimate test of our efforts to increase airspace efficiency and capacity. The

second is taking an evolutionary approach in implementing free flight. We will make absolutely sure that every advanced technology required for free flight works the way we think it should. We will test the concept at each stage to ensure that the cost benefits are as predicted.

As we evolve from today's system, there are four advanced technologies that will make full use of free flight possible: the satellites of the Global Positioning System (GPS), fast, error-free data-link communications between the cockpit and the ground, highly reliable advanced automation systems in air traffic control facilities, and next-gen-

David R. Hinson charts a plan to revolutionize the highways in the sky.

eration Traffic Collision and Avoidance Systems (TCAS) aboard aircraft.

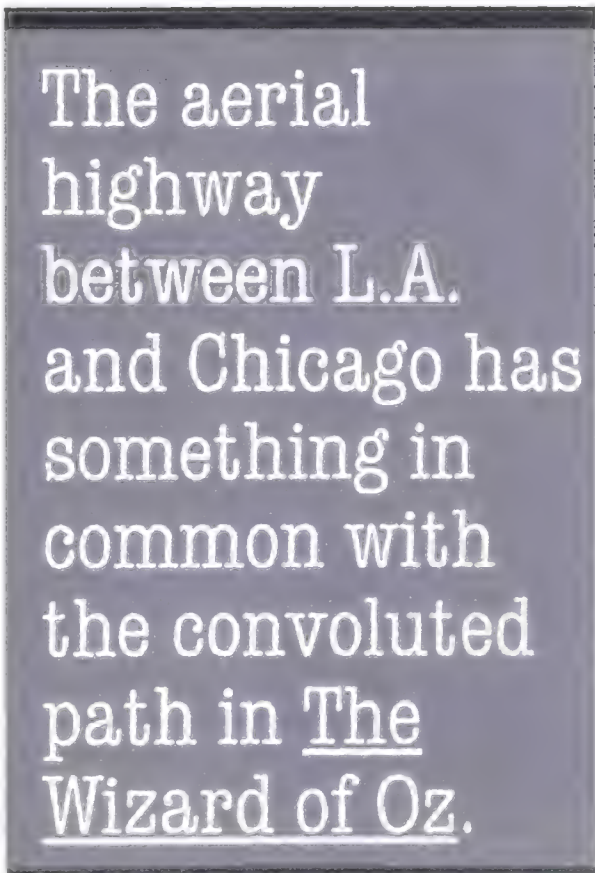
GPS is revolutionizing air navigation. Right now, pilots of GPS-equipped aircraft can use the satellite signals to determine their position within 100 meters—a distance only a little longer than a Boeing 747.

The FAA recently awarded a \$475 million contract to build the Wide Area Augmentation System (WAAS), a network of ground-based stations that will make GPS signals accurate to about seven meters—about 21 feet. That extraordinary degree of accuracy will open virtually every U.S. airport to low-visibility approaches. Today, fewer than 1,000 facilities allow such landings; GPS and WAAS will permit instrument approaches to more than 8,000 airports.

We are already well on our way to making GPS the primary navigation system for U.S. airspace. The FAA expects that by mid-October, it will have 28 GPS airport approaches in place across the nation. We are developing these approaches at the rate of about 15 per week and will inform pilots of them as soon as they are approved.

Data link is already in use at many of our terminals. We began testing the technology over the Pacific in July with Qantas Airways. Sometime this fall, data link will be in operation on United Airlines flights over the South Pacific. Advanced automation equipment is now moving rapidly into the field. This is critical not only to free flight but to enhancing the reliability of our air traffic control systems. The fourth technological element that makes free flight possible, the next generation of TCAS, will detect traffic both horizontally and vertically from the aircraft it is mounted in and give multi-dimensional escape maneuver advisories to pilots. Today's TCAS systems are limited to vertical warnings and advisories.

Some other automated systems, such as software to predict and resolve flight path conflicts, are still on the comput-



The aerial highway between L.A. and Chicago has something in common with the convoluted path in The Wizard of Oz.

erized drawing board. These projected requirements are not in the "Star Wars" class of research and development but neither are they things we can buy at Radio Shack.

The FAA already has a partial system of free flight in U.S. airspace: Last January, in an expansion of the National Route Program, we started offering direct routing to aircraft flying at 39,000 feet on flights of more than 1,500 miles. The ceiling has since been lowered to 35,000 feet east of the Mississippi and 33,000 feet to the west. Eventually we plan to drop the altitude limitations to 29,000 feet, which will open the program to thousands more flights per day.

The expanded National Route Program offers a tantalizing glimpse of the potential economic benefits of true free flight. In July, for example, 149 flights bypassed the traditional flight path between Los Angeles and Chicago, saving a total of more than \$13,000 in fuel costs for that route alone. The total savings to the industry last year—even before the program was broadened—was estimated at more than \$40 million.

The program also makes the details of a commercial flight less complicated for the crew in the cockpit. One pilot told me that his flight plan used to be several pages long. Under the National Route Program, it's down to about one paragraph.

Free flight will not be introduced overnight. In fact, the current structure of air traffic control will continue to co-exist with free flight well into the next century. The International Civil Aviation Organization, for example, requires ground-based navigation aids until at least 2010. And there still will be thousands of "low-end" users in the aviation community who may not have all the technology needed to take full advantage of the concept.

We also must consider the human aspects of such a revolution in aerial navigation. Pilots will take more responsibility for en-route flight path changes and controllers will have to adapt to a different—but no less important—role in traffic management.

We know we are pushing the state of the art as we develop the air traffic system for the next generation of the traveling public. But we have to keep the pressure on. Last year, the system moved 555 million passengers. But FAA forecasts predict that 800 million passengers per year will be flying in less than a decade, with more than *one billion* flying annually by 2010. Aircraft manufacturers predict that 8,000 to 10,000 new airliners will be built worldwide to meet future growth. If just 30 percent are purchased by U.S. carriers, that will require us to find ways to handle as many as 3,000 more airplanes safely and efficiently. I believe rapid development and implementation of free flight is the key element in helping us meet that challenge as American aviation enters the 21st century.

The author is the administrator of the Federal Aviation Administration.

Descent to Mars

by Jon Krakauer

Photographs by David Harris

Dwarfed by a stone arch in New Mexico's Lechuguilla Cave, researchers stay together as they look for life 900 feet below ground.

I awoke face down in the dirt, dripping with sweat, engulfed in darkness so absolute it made no difference whether my eyes were open or closed. Groggy and disoriented, I bolted upright and tried to figure out where in hell I was. Then I remembered, and a wave of claustrophobic panic rose in my throat: I was a

thousand feet underground, in a labyrinth called Lechuguilla Cave.

I groped inside my sleeping bag until I found a flashlight, and flicked it on to curb my overactive imagination. The beam illuminated a low, domed chamber the size of a parking garage. Adorned with outlandish limestone formations resembling curtains and udders, my

surroundings brought to mind the set of a low-budget science fiction movie. Which was appropriate, in a sense, because three of the nine people sleeping on the rocky ground nearby had spent a good part of their careers thinking about conditions on other planets. NASA researchers Chris McKay, Penny Boston, and Larry Lemke had descended into



If this somewhat unusual team of spelunkers is correct,
we've been looking for Martian life in all the wrong places.

this disquieting netherworld because, as McKay had explained earlier in an apparent non sequitur, "We want to know if there's life on Mars."

It had not been easy getting here. The mission had been launched two days earlier, from a parched New Mexico hillside freckled with prickly pear and lechuguilla plants—the spiny agave

after which the cave was named. Located in Carlsbad Caverns National Park, just a few miles from those renowned formations, the unmarked entrance to Lechuguilla appeared as a forbidding vertical shaft gaping from a limestone outcrop. Wearing helmets, headlamps, mountaineering harnesses, and 50-pound backpacks, we attached our-

selves to a frayed rope, shuffled backward over the edge, and rappelled one by one into the gloom. Within moments we found ourselves in an environment that felt as alien as some distant corner of the galaxy.

Now considered one of the most spectacular and geologically interesting caves in the world, Lechuguilla was



Biologist Larry Mallory undergoes the first trial facing visitors to the cave: rappelling down its vertical entrance.

Expedition members pick their way along a steep trail en route to the base camp, a cavern named "Deep Secrets."

once thought to extend no farther than the two rooms beneath its unremarkable 90-foot entrance pit. At one edge of the pit, however, cavers noticed a distinct breeze blowing from a pile of rubble, inspiring them to probe deeper. On May 25, 1986, after a decade of intermittent excavation, three men finally dug through the last of the rubble and discovered a narrow, twisting passageway leading down into the bowels of the earth.

One of the trio who made this discovery was a caver named Rick Bridges, who helped guide our expedition into Lechuguilla last December. The trip down was long and arduous. The temperature remained a constant 67 degrees Fahrenheit, which initially seemed quite comfortable. But the humidity hovered near 100 percent, so the slightest physical effort produced a flood of perspiration that soaked our clothing and never dried.

Bridges guided us down a route that corkscrewed through a devious geo-

logic honeycomb. Bearing all our food and equipment on our backs, we slithered like lizards down narrow slots, scrambled through a chaos of truck-size boulders, and dangled tenuously above yawning chasms. At times we used ropes and specialized caving gear to rappel into pits that plunged into nothing. Knowing that we would have to ascend these same sheer precipices to return to the surface five days hence, I felt my anxiety rise as we pressed deeper underground. Our battery-powered headlamps became our most valuable possessions. Indeed, each of us carried at least two backup lights, because without a means of illumination we would be blind, helpless, and stranded.

Although fraught with hazards, Lechuguilla is a place of phantasmal beauty. Cramped, twisting passages open suddenly into spaces as cavernous as Madison Square Garden, the walls sparkling with brilliant white crystals. Opalescent "cave pearls" lie in clusters at the bottom of shallow pools. Everywhere I turned there was one or another exotic embellishment, otherworldly and dazzling.

The NASA crew, however, was uninterested in such lovely sights. What had lured them into Lechuguilla were the ugliest parts of the cave—a handful of comparatively unadorned areas coated with a nasty, mud-like substance known as corrosion residue. Cavers called it "gorilla poop" (actually they used a less polite term). It was impossible to touch the stuff without becoming filthy, but McKay, Boston, and Lemke found it extremely stimulating. They believed that corrosion residue might hold important clues about Mars—an object of passionate interest to all three, and their sole reason for visiting Lechuguilla. Specifically, they theorize that corrosion residue might help answer questions about whether life exists on the Red Planet.

Photographs of Mars show that water once flowed there, and long ago it may also have had a fairly substantial

atmosphere. Today the planet is a harsh place, brutally cold and without liquid water. The atmosphere is exceedingly thin. "The surface would seem to be very inhospitable to life of any kind," McKay acknowledged. "If life does exist on Mars, you'd expect to find it underground. Organisms would be shielded from the intense ultraviolet radiation there. A volcanic heat source might conceivably generate liquid water from subsurface ice. In the absence of sunlight and organic matter, any extant life would have to derive its energy entirely from mineral sources." To put it simply, any life-forms would have to eat rocks.

Creatures of that ilk do in fact exist here on Earth. Biologists call them autotrophic organisms, and they have been found living around hot volcanic vents on the ocean floor, among other places. Not a lot is known about them, but McKay, Boston, and Lemke speculate that similar critters might flourish in caves on Mars—and in the dark recesses of Lechuguilla.

Deep in Lechuguilla, many of the fundamental reference points that lend order to everyday life cease to exist. There is no weather in the cave, no natural horizon, no noise, no sunrise or sunset, no way to tell what time it is, what day, what year. Lacking visual cues, we found ourselves keeping odd hours. Larry Lemke, a compact, 47-year-old engineer from NASA's Ames Research Center in California, crawled out of his bivouac sack at 10 a.m. and said, "My biological clock is already drifting. I seem to fall into a 25-hour day down



here—just like you would on Mars, which has 24-and-a-half-hour days.”

Stiff and hungover from the strenuous trip down, the team assembled for breakfast on a gravelly hummock. This chamber, named Deep Secrets by the cavers who discovered it, would serve as our base camp for four nights. I dug into a plastic pouch of cold freeze-dried chili left over from yesterday’s dinner—not because it tasted good but because if I didn’t eat it I’d have to carry it back up to the surface. To keep Lechuguilla pristine, everything that came in with us would have to go out with us. Even human waste would be sealed carefully in Ziploc bags and carried out.

We were on our own down here, cut off from the rest of the world. The implications of that were not lost on anyone. In 1991 an experienced caver named Emily Mobley broke her femur not far from the Deep Secrets camp when an immense rock rolled onto her thigh. It took 160 cavers four days to get her back to the surface.

Our isolation—and our need to be

self-sufficient—was analogous to a space journey, suggested Lemke, who studies robotic locomotion and who has designed several missions to Mars for NASA. “This cave is an alien world,” he said, “with its own special rules and hazards. Living down here is difficult. It’s given me some practical insights into the challenge of doing research halfway across the solar system.”

The research scheduled for this morning would be conducted a mere quarter-mile from camp, but getting to the site posed enough problems to keep plenty of insights flowing Lemke’s way. After loading up our backpacks with scientific paraphernalia, we negotiated a passage called the Fortress of Chaos, which was rather like squirming through a humongous chunk of Swiss cheese. At the top of the Fortress a strand of

Penny Boston and Rick Bridges collect samples from a shallow pool. When she gets them back to the lab, Boston will test the samples for signs of life.

rope hung from a shadowy hole overhead. Clipping small, ratchet-like devices to the rope (called ascenders, they slide upward freely, but cleverly grip the line when weighted), we hauled ourselves toward the ceiling with much huffing and puffing.

The rope led through a sugary white tunnel of gypsum crystals to emerge in an expansive chamber stacked with huge, tottering boulders. When they saw that the entire room was coated with the filthy brown scum of corrosion residue, McKay, Boston, and Lemke grew ecstatic.

Chris McKay, 40, is a six-foot-six beanpole of a man with a scraggly beard and a wry sense of humor. Forty-one-year-old Penny Boston is smallish and voluble. A mop of curly blond hair cascaded haphazardly from beneath her helmet. Neither McKay nor Boston is particularly athletic, nor could either be called a thrill seeker. Each had left behind a spouse and a young child to make the trip.

Given that both Boston and McKay





claimed to abhor being underground. I had to wonder why they'd come here. Why, indeed, hadn't they simply asked a team of experienced cavers to collect a sample of corrosion residue and deliver it to their labs?

Such a question, McKay observed, "gets to the very nature of fieldwork. Why couldn't we simply use surrogates? I don't really know the answer, but I know it doesn't work. There is just no substitute for being there in person. Experiencing the environment with your own eyes and your full attention—both conscious and unconscious—is essential. Surrogates can't give us the understanding we develop by going into the field ourselves, taking samples in real time, and discussing things on site."

Hence the numerous extended visits McKay has made over the past 15 years to places such as the Gobi Desert, Chile, Siberia, the Canadian Arctic, and the dry valleys of Antarctica—all extremely remote and inhospitable locales that have provided McKay and his NASA colleagues with invaluable theoretical musings about the nature of life on Mars and how to look for it.

"As you might imagine," McKay continued, "the same question comes up time and time again during discussions about whether it's necessary to send humans to Mars. I happen to think that it is necessary, since we won't know exactly what we're looking for until we get there. We'll be depending a lot on the intuition of the scientists involved. They'll know what's important when they see it."

McKay and Boston met as students at Florida Atlantic University in 1972 and have remained fast friends over the decades. Both have been fascinated with space since childhood. In 1976, the Viking missions to Mars crystallized that fascination into a scholarly quest for knowledge about the fourth

planet. "I remember the Viking landings as incredibly thrilling events," Boston recalled. "They got us really turned on."

"Viking told us very clearly that all the elements for life were present on Mars," said McKay, "yet there was no life there—the lights were on but nobody was home. That really piqued our interest. Was there life on Mars in the past? Could it harbor life in the future?"

McKay and Boston were both graduate students at the University of Colorado when Viking landed. In 1981, as a school project with a half-dozen other Mars fanatics, they put together an ambitious seminar christened The Case for Mars Conference, the primary goal of which was to advance an argument for the human exploration of the Red Planet.

"We were just a bunch of students," Boston said. "We had no money, no influence. Basically, we started calling up famous Mars scientists and inviting them to our conference, and much to everyone's surprise some big names like Conway Schneider and Ben Clark agreed to come." (Schneider and Clark were both leading scientists on the Viking mission.)

The Case for Mars Conference proved to be a roaring success, and was reconvened every three years thereafter. A passionate, if unofficial, network of Mars scientists and aerospace engineers coalesced around these parleys; dedicated to keeping Mars exploration on the national agenda, the group started calling itself the Mars Underground (see "Mars Direct," Apr./May 1994).

McKay was quick to point out that the Underground is not interested in putting a person on Mars merely as a grand adventure or symbolic act—the members believe it should be more than an Apollo-like exercise in national chest-thumping. "We don't want to simply go to Mars, say 'Hi!' and come home," he insisted. "We hope to conduct serious research there—we want to know if there is life on Mars, or has been in the past. Imagine what it would mean to discover that we are not alone in the solar system."

Facing a head-high limestone boulder plastered top to bottom with gorilla poop, Penny Boston placed four

Researchers Chris McKay, Penny Boston, and Larry Lemke (top to bottom) theorize that hostile environments like Lechuguilla Cave's could host life-forms that will teach them what to look for on Mars. Although their primary interest is in corrosion residue, Lemke stops to appreciate some aragonite frostwork.



For the five days they're underground, Boston, McKay, and Lemke call this patch of gravel home.

A formation called "The Three Amigos" was formed by dripping water that gradually wore away a gypsum deposit.

tium, which meant that all the water now in Lechuguilla percolated into the cave before the widespread nuclear bomb testing of the 1940s and '50s.

As cavers ventured into the depths of the cavern they came across the bones of a few bats, and even the fossilized remains of a prehistoric camelid (a camel-like creature, indicating that long ago Lechuguilla was accessible from the surface), but the deeper reaches of the labyrinth appeared to be completely devoid of life.

Then, in 1990, a U.S. Geological Survey scientist named Kim I. Cunningham made an astonishing discovery. While studying a chunk of calcite from the deepest point in the cave under a scanning electron microscope, he noticed some peculiar filamentous strands usually found near concentrations of iron, manganese, and sulfur. "Kim's not a biologist," said Boston, "but he's a

laboratory slides on a narrow ledge. On a subsequent trip she will collect them to see if any bacterial cultures have taken hold. Nearby, Chris McKay extracted a speck of fluffy, brownish-orange corrosion residue with a Swiss army knife and placed it on a hand-held electronic pH meter. The gauge registered 1.3, prompting him to exclaim, "Wow, this stuff is acid. No wonder it's eating up the limestone."

Corrosion residue is typically found in relatively lofty reaches of the cave, where updrafts of warm air collide with cooler rock. According to the conventional wisdom, the stuff is the by-product of an inorganic chemical reaction between humid, acidic air and the soluble limestone. The Mars Underground crew has an entirely different theory, believing corrosion residue to be biological in origin. "It's our hypothesis," said Boston, gesturing to the brown crud covering the rocks around her. "that all this nasty stuff has been produced by bugs—a population of microbes native to this cave."

When Lechuguilla was first explored in the late 1980s, it was assumed to be virtually sterile. The rubble that had hidden the entrance from spelunkers

had effectively closed the cave to the outside world. Even the water in the cave was free from surface contamination: Analysis showed no trace of tri-





Toting lab equipment is out of the question in a place where just getting around is problem enough.

Mallory, who proved that some of the cave's microbes oxidize manganese, places new samples in test tubes.

bright boy. He thought these things looked an awful lot like some kind of fossilized microbial life."

In the meantime, members of the Mars Underground continued to study the data returned from Viking and other probes and drew conclusions about the life-forms likely to survive in Martian conditions. Ben Clark published a seminal paper on a hypothetical ecosystem that would make use of the large amount of sulfur in the Martian soil. And Boston and McKay co-wrote a paper with Russian microbiologist Mikhail Ivanov on the likelihood that microbes could dwell in the subsurface of Mars. They based some of their argument on studies of sulfur-metabolizing microbes that have been found in sulfur-rich areas on Earth: hot springs, lakes, and the Dead Sea.

Shortly thereafter, Larry Lemke's wife was watching a National Geographic television special about Lechuguilla. "Larry," she called to him in the next room, "you should come in here and take a look at this." Lemke arrived in time to see a brief mention of Cunningham's discovery and a description of Lechuguilla's geology.

The majority of the world's limestone caves were dissolved from the sur-

rounding bedrock by mild carbonic acid. Lechuguilla is fairly unusual in that it was probably formed by sulfuric acid produced when hydrogen sulfide gas percolated up from nearby oil fields and reacted with oxygenated groundwater. The copious deposits of gypsum in Lechuguilla were created as a by-product of this reaction. Sulfur was another by-product.

"A light bulb immediately went off in my head," Lemke said. There ensued a marathon cross-country conference call between Lemke, Cunningham, McKay, and Boston. The upshot was the first NASA mission to search for microbial life in Lechuguilla, conducted in April 1994 and including Larry Mallory, a microbiologist at the University of Massachusetts at Amherst, and Diana Northup, a biologist at the University of New Mexico at Albuquerque. Mallory also accompanied this December expedition, the second search for life in the cave.

Microbes may be tiny, but they have to eat. "In most caves," explained McKay, "the microbes you find eat organic stuff—bat guano, say, or other nutrients washed down from the outside. What's so interesting about Lechuguilla is that it's isolated from the surface, so there is no sunlight for photosynthesis and no source of organic energy. Any bugs living down here have to be metabolizing inorganic minerals."

McKay and his colleagues speculate that sulfur serves as one energy source

for a complex microbial ecosystem, the most visible sign of which is the wealth of corrosion residue. Though the NASA folks admit they are a long way from proving it, they believe that corrosion residue is organic waste produced by rock-eating autotrophic bacteria. It's not gorilla poop that coats these cave walls, in other words—it's bug poop. McKay and Boston are now working to prove this hypothesis, building on research by Kim Cunningham, Larry Mallory, and Diana Northup.

The NASA researchers have already proved that living organisms are present in the cave. After collecting samples in test tubes, they added stains that fluoresce only in the presence of active metabolism. The results were positive. They have also grown samples from the cave in media containing manganese and have shown that the samples oxidized the manganese—turned it dark. And they have found active DNA.

The scientists hope to develop cultures of the cave specimens that will enable them to identify the organisms and determine their relationships to one another. The results should ultimately help them with the question they're really interested in: As Boston put it, "Do bugs like this also live on Mars?"

Unfortunately, the Lechuguilla microbes have so far proved difficult laboratory subjects. "It's tough to bring them back alive," said Boston. "They're used to a homogenous environment—always dark, always warm, humidity never varies. We scrape stuff up and dump it into a liquid or semi-liquid or even a solid medium, and only some will tolerate it. Others are saying 'Well, we think we'll die now because this is just too weird for us.'" Boston said they'd like to bring lab equipment into the cave, but "the problem is you just get massively banged up. It's so hard to move around down there, and the weight of the equipment is a big deal."

So they are pretty far from their goal of finding evidence of a sulfur-metabolizing organism in Lechuguilla, let alone demonstrating that similar critters live on Mars. Back at the Deep Secrets base camp, squatting in the dirt over a dinner of reconstituted chicken tetrazzini, Lemke emphasized that "landing humans on Mars to prove that microbial





Even the bland earth tones of a desert landscape seem electric to eyes that haven't seen sunlight for five days.

life exists there, or once existed there, is a very daunting challenge. The round trip would take a minimum of 600 to 1,000 days. The technological obstacles would be huge.

"I think we're at a crisis point," Lemke warned glumly. "For a long time the space program was a way to conduct the cold war by other means. We all got behind the Apollo program to beat the Russians to the moon, and as a cultural event it made the entire country feel great. Now that we've won the race, we have to ask ourselves if we're willing as a nation to continue doing space exploration for its own merit. I think it's an open question."

"Which brings us back to what we're doing in this cave," McKay chimed in. "Part of our work is to establish a clear goal—to answer the question 'Why go to Mars?' We think the best answer is 'To look for life.' People can grasp that. It has universal appeal. By going to places like Lechuguilla—by digging up weird life-forms and saying 'Look folks, this is interesting stuff and it could also be happening on another planet'—we hope to build enthusiasm for eventually going to Mars."

Nobody in the Underground thinks

getting to Mars will be easy—politically or otherwise—but they are patient people, and determined. The trip into Lechuguilla has only fanned the flames of their ambition. In 1997, NASA plans to land another unmanned spacecraft on Mars, and the people of the Mars Underground are aggressively pushing to equip that lander with drilling equipment, enabling it to make at least a cursory probe of the planet's subsurface.

Boston said the prospects for the Underground's research efforts are good; nevertheless, she added, "I think there's a major object lesson in this for those of us planning the search for past or present life on Mars. It's damn hard even here on Earth—where we are awash in colleagues to consult and sophisticated laboratories to work in. We've only just begun to convince other scientists that there is indeed life in Lechuguilla. How then to convince them that there is life on Mars when we someday arrive there?"

Out in front of the NASA team, hours into the long ascent from the depths of Lechuguilla, I rounded a bend to encounter something so strange and unexpected that it took me a few moments to recognize what it was—a cool breeze blowing across my grimy, sweat-drenched skin. A little farther and I arrived at something even stranger—a ray of sun-

light, leaking exquisitely through a crooked fissure overhead. I was almost back to the surface.

The last remaining obstacle was a vertical 60-foot climb out of the guano-sparkled entrance pit. Muscling up the final strand of rope was strenuous, but I was so relieved to be escaping the underworld that I scarcely noticed my labored breathing and cramping arms. Just before noon I pulled over the lip and emerged into a brilliant New Mexico morning.

Sunlight washed over my chest and face. I inhaled a greedy lungful of desert air, savoring the sweet scent of juniper and sage. The colors that flooded my light-starved retinas—the blue of the sky, a pale green drift of cactus, the creamy palette of the clouds—seemed electric, surreal, almost overwhelming. An involuntary whoop of joy erupted from my throat. I felt as if I'd just been released from prison.

Inebriated with a newfound appreciation of the ordinary, I imagined for a moment that I was getting a taste of what an astronaut might experience on his or her return from a mission to Mars. Then I remembered that I'd been away from the world for a mere five days. My God, I wondered; if I'm this discom-bobulated by an absence of less than a week, what would it feel like to return to Earth after a journey of two or three years? ➔



RUNWAYS OF

THE FUTURE

Idea: To nullify threats to air bases, simply eliminate the bases. A series of remarkable flights during the 1950s showed it could have worked (for one-way trips).



by Ed Regis

The problem with airplanes is that they need runways, and in wartime, the average runway might as well have the words "BOMB HERE" painted on it in big block letters. Runways are among the first targets bombed when a war starts, so over the years people have hatched various schemes to build combat airplanes that don't need a vulnerable stretch of pavement.

Seaplanes substitute water for concrete, but when the Jet Age came along, seaplanes proved ill-suited to the higher speeds. The Navy's Convair Sea Dart, essentially a jet fighter on water skis, experienced such severe vibration on take-off that the testing program was scrapped after only five of the model had been built.

Vertical-takeoff-and-landing aircraft like the turboprop-powered Lockheed XFV-1, Convair XFY-1 "Pogo," and pure-jet Ryan X-13 Vertijet were all designed to operate without runways. But the turboprop "tail sitters" were not popular with their pilots, who had to look over their shoulders to make the necessary tail-first, feel-your-way-down landings. The X-13 had the same problem, and none of the three went beyond the experimental stage.

In the 1950s the ultimate solution appeared on the conceptual horizon: the portable runway. The idea arose in the minds of planners to put rocket-boosted jet fighters on the

decks of flatbed trailers. By adding a solid rocket booster powerful enough to catapult the airplane to flying speed, they could reduce the runway to a short ramp that could be hidden until it was needed, or towed around so its position was constantly changing. Then, when the time came, the crew could simply stop the truck, set up the launcher, and fire the airplane.

For all its apparent craziness, the plan had significant advantages. It gave Air Force planners unprecedented freedom and mobility: The aircraft weren't tied to a known location. For another, the concept promised total immunity from the "Bomb Here" problem posed by a fixed runway. You didn't even need a road; you could drive the trailer into a wheat field, desert, or cow pasture, raise the airplane's nose to its firing angle, light the engine, afterburner, and rocket, and off you'd go. Theoretically, you could also park the truck in a garage, barn, or mountainside cave and launch the airplane from inside the enclosure. The aircraft would be fully airborne even before clearing the hangar doors.

As odd as these ideas seem today, they were all developed and tested with real, full-size, fully loaded fighters. And they worked perfectly, time and again, though the whole concept ignored one question: After a jet was launched, where would it land? As it would turn out, the ultimate mission for truck-launched airplanes rendered the question irrelevant.

It took 130,000 pounds of thrust from a Rocketdyne solid rocket booster to kick a fully loaded F-100D into the air.

The Air Force's jets-on-trucks concept had its roots in the early days of aviation, when a few forward-looking aero-



The Super Sabre, the Air Force's first operational supersonic fighter, was inclined about 20 degrees for launch. Equally important was the angle at which the booster was installed; if it wasn't correct, the fighter would pitch over on launch. Tests with dummies called "iron birds" preceded manned flights.



NORTH AMERICAN AVIATION (2)

nauts first mated rockets and gliders. In Germany, first Friedrich Stamer (in 1928), Julius Hatry, and finally Fritz von Opel (both in 1929) flew gliders that were boosted aloft by solid-propellant rockets—the earliest known examples of jet-assisted takeoff. The first flight of a conventional aircraft boosted by JATO was made in 1929, when an overloaded Junkers W33 seaplane took off from the Elbe River near Dessau, Germany, with the aid of six black-powder rockets. In 1941, Homer A. Boushey, a U.S. Army Air Corps pilot, achieved a milestone when he took off in a two-seat Ercoupe solely on the power of a rocket.

Boushey, a Stanford graduate and former airmail pilot, had been so gung-ho about rocketry that in 1939 he'd written to Robert Goddard at his Roswell, New Mexico testing location and later traveled to the site to visit the pioneering rocket scientist. While he was stationed at Wright Field in Ohio, Boushey was assigned to the aircraft lab to investigate rocket propulsion. Meanwhile, at the California Institute of Technology, Theodor von Kármán and his staff had, after several failures, managed to produce small rockets reliable enough to be attached to a light aircraft. Boushey came up with the idea of putting them on the Ercoupe.

"The idea was we wanted to get as light a plane as we could," Boushey remembers. "The Ercoupe belonged to the Army Air Corps. I flew it out from Wright Field to March Field in California, where we made the test." The tests, conducted in August 1941, were highly successful: three solid-propellant rockets were strapped under each wing of the airplane, and the Ercoupe took off in about half the length of runway it normally used.

At the end of the tests, Boushey recalls, "von Kármán said, 'Just for history, let's unscrew the propeller and be the first to fly an airplane with rocket power alone.'"

To be sure of getting off the ground, they doubled the number of rockets and started the airplane rolling by towing it with a rope attached to a truck. Boushey left the cockpit canopy open and held the end of the rope in one hand. Thus was born the little-known and short-lived concept of Rocket-n'-Rope-Assist.

"I guess I must have gotten 30 or 40 miles an hour before the tension got too great for me to hold onto," Boushey says. "Then we lit the rockets—we put 12 on instead of six—and it took off in a hurry."

A dozen years later, JATO technology had improved to

the point that the Air Force wanted to demonstrate the concept of zero-length launch. After all, early cruise missiles were routinely launched from short ramps; why couldn't ordinary aircraft, appropriately souped-up with the latest in rocket boosters, do the same? As for the landing run, you could shorten that too, by equipping the airplane with a tailhook that would engage an arresting cable, allowing the airplane to slow abruptly and settle onto a huge (80- by 400-foot, 30-inch-high) inflatable rubber pad. The theory was that the jet would descend gear up, snag the cable, whomp onto the slick surface (which had been lubricated with something suitably slippery), and slide to a stop on its belly.

It was the kind of scheme that only a rocket booster manufacturer intent on opening up a vast market could love. Clearly, the whole system—which came to be known by the acronym ZELMAL (zero-length launch and mat landing)—would have to be tested. Testing began at California's Edwards Air Force Base in December 1953, with rocket-assisted Republic F-84G Thunderjets flying from a trailer-mounted aircraft launcher. The takeoffs were uniformly successful. "The airplane was completely under control and the pilot was flying the airplane from X minus zero," recounted a declassified secret report on the project. "There was nothing to it," says George Rodney, who flew some of the launches. "It was a very nice takeoff."

The mat landings were another story. The underlying rationale was simple enough: The object was to land very short. This could have been accomplished with aircraft carrier-type arresting cables alone, but that would have required strengthening the airplane's landing gear so it could survive the tremendous G-forces and impact produced by the arrests and recoveries. The purpose of the mat, with its rubber air cells, was to absorb the shock of sudden deceleration and thereby eliminate the need for landing gear altogether. In return, the airplane would be able to carry another 500 pounds of bombs or fuel.

"You didn't have to design the plane for the huge Gs that you get in a carrier airplane," says Rodney. "Any Navy airplane has a very distinct weight penalty because of all the beef that has to be put into the landing gear. What the mat did was allow you to take a typical Air Force design—a standard fighter—and make an arrested landing with it.

"The other issue is that you can carry the inflatable mat; you just dump it onto an unprepared field," he adds. "The whole mat was truckable. It all fit on a couple of trailer trucks."

In practice, though, this miracle appliance didn't work out too well. The mat leaked the first time it was set up, and several of the rubber air cells had to be sent back for repair to the Goodyear Tire and Rubber Company, which had manufactured them. As for the landings themselves, "The initial mat landing was performed on 2 June 1954 but it was unsuccessful," according to the declassified report. "The F-84G test aircraft, USAF S/N 51-1225, piloted by Robert Turner, Glenn L. Martin test pilot, was wrecked beyond economical repair. Turner received back injuries which grounded him for several months." (He later recovered but died in 1969 while testing a Martin-built B-57.)

Turner's tailhook missed the arresting cables and tore through the surface of the mat, puncturing three air cells.

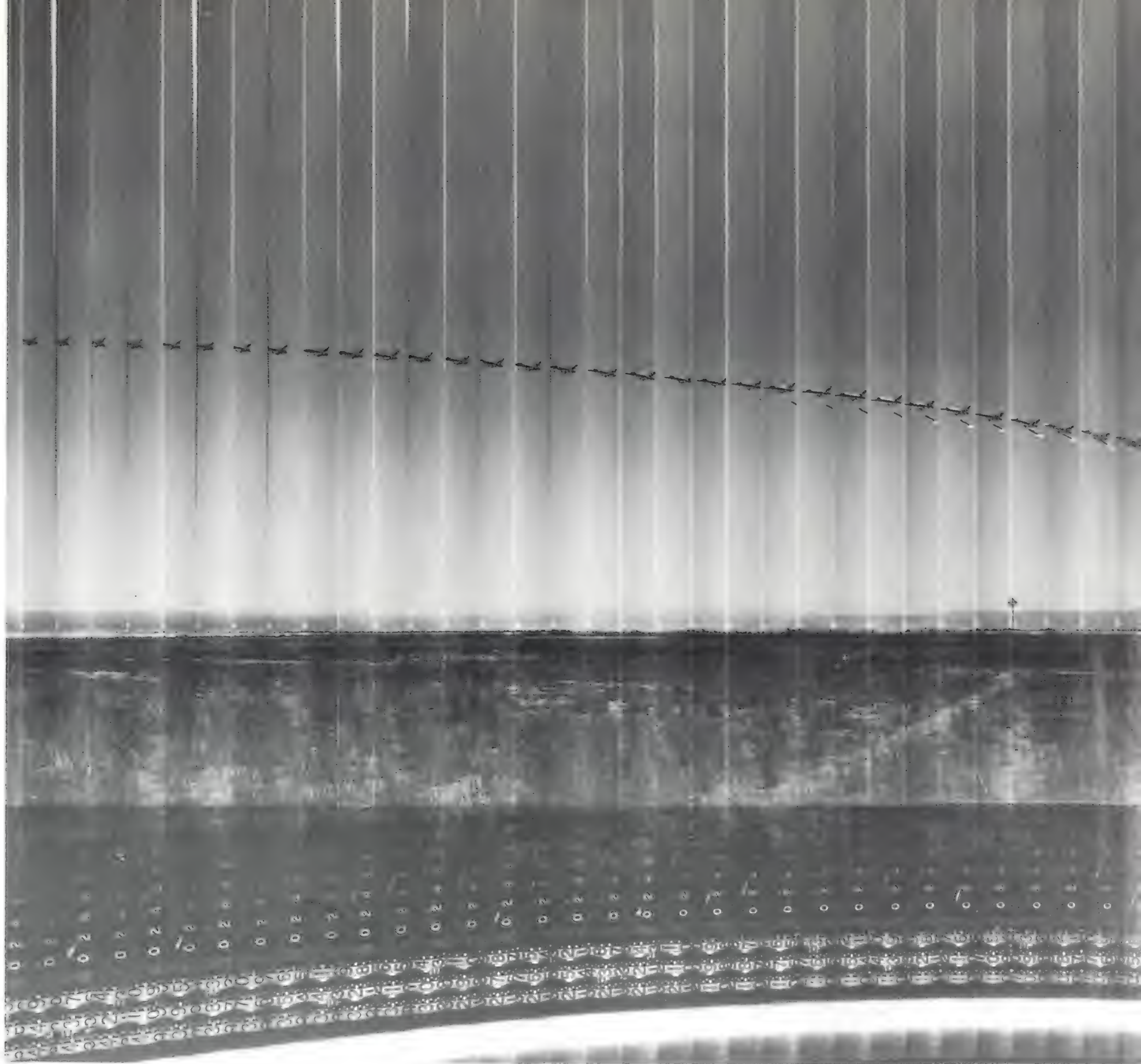
Like many test pilots, Al Blackburn (right) says he was "always into cars." It may have helped that his father worked for General Motors.

After being released from active duty, the veteran test pilot landed at North American Aviation in California (below).



The mat was again repaired by Goodyear and readied for another attempt. Two more test landings met with better results. Still, during the second landing the pilot suffered a strained neck—"due to the high pitching rate (62 deg/sec) when the hook engaged the arresting cable." On the third try the aircraft behaved the way you'd expect of a 15,000-pound object smacking into a pneumatic tube at 144 mph: "The airplane hit 10 degrees nose down, bounced level, and then pitched 11 degrees nose down again."

But that was how it was supposed to work. "That was more or less the way the thing was designed," says Rodney. "The



The solid-fuel booster burned for four seconds, giving the pilot a nearly 4-G ride and accelerating the fighter to 275 mph.

plane would hit and bounce up and pitch a little bit, and then come to a halt. When you hit the cable, it essentially brought you to a halt in mid-air. Then it pitched you into the mat, and the mat of course was resilient, and it threw you back up in the air again. Not very far. Four or five feet, I would guess."

The one thing the mat did not do, however, was bring the pilot's head to a safe and gentle halt. "We tied ourselves into the seat real well, so we wouldn't pitch forward into the control column and into the instrument panel, but unfortunately your head, it goes through a big arc and comes down on your chest," says Rodney. "Your head came forward like a shot, and I ended up with a gimpy neck. Even right now I have a little after-effect from that—one of the few [bad] things that ever happened to me in flying."

Originally, 30 mat landings had been planned, but the pro-

gram was canceled after just three attempts. "Sufficient data had been obtained on the two successful landings for the evaluation team to complete their report," said an official summary of the tests. And at that point, after a total of 28 launches, 25 conventional landings, and three mat landings, the ZELMAL project was considered closed.

"It needed some more work, that was for damn sure," says Rodney. "At the end, the Air Force had no interest in it whatsoever."

The zero-length-launch concept, though, survived. Military planners could not let go of the idea of dispersed, mobile, A-bomb-equipped jet fighters instantly launchable from roadside rest stops. The mat landing was easily dispensed with. The point of the exercise was to present a credible deterrent to an enemy's first strike, and for that all you needed was a flock of nukes headed off toward Moscow. The whole question of landing—a question nobody seemed to ask—was simply irrelevant.



NORTH AMERICAN AVIATION

Which he always did. But then there was the time he fell asleep in flight.

"I was up in a Corsair putting in my two hours of night time—you know, just to fill up my logbook—and I was up there droning around, and it was kind of dull, and I fell sound asleep." He woke up after a period he estimates was "no more than 30 seconds."

Blackburn graduated from the Naval Academy as a Marine, fought at Okinawa, returned to the States, and became a carrier-based fighter pilot. After leaving the service in 1949, he got a master's degree in aeronautical engineering from the Massachusetts Institute of Technology, then was recalled during the Korean war and spent a couple of years test flying for the Navy at the Naval Air Test Center at Patuxent River, Maryland. In 1954, he became an engineering test pilot for North American Aviation in Los Angeles. At the company's Palmdale flight test facility, he earned the title of Glider King when, within one two-week period, he experienced unrelightable flame-outs in three successive F-86 Sabrejet flights and managed to land all three craft. By 1957, when he was asked to participate in the resurrected zero-length-launch project, he was ready for just about anything.

"I thought it was interesting," he says. "It sounded like a neat idea."

Although the F-84 tests had demonstrated the general feasibility of zero-length launch, a whole new genera-

The ZEL project was revived in 1957, the idea now being to launch the airplanes from roving trailer trucks and have the pilots, once their missions were accomplished, eject. "You may not find any place to land, [so] you just punch out when you get back to friendly territory," says Al Blackburn, who flew this second series of tests. "You hope you get back to friendly territory, but what happens to an airplane after you drop nuclear weapons is of very small consequence."

It's not surprising that Blackburn remains unruffled by the thought of a one-way flight. A preternaturally calm test pilot, Blackburn had acquired the reputation of being a little on the overly relaxed side. He recalls that during ground school, "I would always nod off, and the sergeant—or whoever was doing the instruction—would be yelling at me, and after a while he'd say, 'Okay Lieutenant Blackburn, you stand up. If you can't stay awake sitting down, you remain standing.' And then the whole class would get absorbed because I would fall asleep standing up too, and I'd start falling over, and people would wonder if I was going to catch myself."

tion of jet fighters had arrived on the scene. This time around, the workhorse would be the North American F-100 Super Sabre, the world's first supersonic jet fighter. At 35,000 pounds, the F-100 was more than twice as heavy as the F-84. Could the heavier fighter, equipped with a nuclear warhead (the so-called T-63 store), still be fired off a flatbed truck?

The first thing Blackburn did was have a talk with Bob Turner, who'd flown the first F-84 tests. Turner had a no-sweat attitude about the whole thing, comparing the takeoff to a conventional catapult launch from an aircraft carrier. He did have one suggestion for his successor: Make sure you are in sole control of the moment of firing; that way, you can brace yourself for the blast.

The blast would indeed be something to prepare for. The Rocketdyne solid-propellant booster would generate 130,000 pounds of thrust for four seconds, and at burnout the F-100 would be at an altitude of 400 feet and traveling at 275 mph. Supposedly, it would be airborne after a total takeoff run of three-eighths of an inch, the actual length of the ramp that



guided the airplane during the initial instant of its launch. During launch, the pilot would experience a maximum force of 3.5 to almost 4 Gs.

Blackburn went back to Patuxent River for some catapult work, and later took a few rides in the centrifuge at the University of Southern California, some producing as much as 13 Gs—all of which left him pretty much unfazed. Of more concern to him was the matter of booster alignment. It was essential that the booster's center of thrust pass through the airplane's center of gravity, or else some rather stellar nose-up or nose-down effects would result. Well before they tested a real F-100, engineers ran a series of launches using a steel-and-concrete dummy called an iron bird. During one test launch, an iron bird did a backward somersault and a few other uncontrolled aerial maneuvers, so everyone knew the booster's thrust line was critical.

But the first manned shot went perfectly. "It was exhilarating! It was just as predicted—no surprises," says Blackburn. "A great feeling of acceleration, like you get on a roller coaster. It's better than any ride you can find at Disneyland."

Not until the next flight did a problem emerge, when the rocket booster wouldn't separate after burnout. This was a

Experiments with a two-seat Ercoupe led to wider use of rocket-assisted takeoff and, eventually, Zero Length Launch.

cause for concern because there was no way to land the jet with an empty rocket bottle dangling from it like some kind of malignancy. Blackburn flew around for an hour and a half trying various tricks to nudge the thing loose, but nothing worked. He finally ejected, somersaulted, and made a rough landing in a 35-mph wind. The F-100 augered in nearby.

A postmortem revealed that the booster had gotten hung up on the attachment bolts, which were supposed to shear off but hadn't. Blackburn's next airplane was equipped with a redesigned booster attachment system featuring explosive bolts that could be detonated on command. After that, there were no problems of any consequence. Between March and October of 1958, North American performed 14 successful launches, often making one flight per week. The whole procedure became so routine that when Air Force pilot Bob Titus flew a public demonstration of the concept at Nevada's Nellis Air Force Base, he executed a roll after burnout. ("I did it as I came off the launcher," he recalls. "It was a four-

second rocket burn, and when the rocket fell off I did a roll. It's only every now and then that you get to shine in front of a crowd.")

At this point the feasibility of zero-length launch was, if anything, overproven. With a properly modified airplane, the whole procedure was trivial: You could set up for launch in about five minutes. "Probably you could do it in less if you were on really high alert," says Blackburn.

But just when all of it had been proven beyond reasonable doubt, serious misgivings arose about the whole idea. Europeans were growing wary of schemes in which nuclear exchanges took place above their towns, and the prospect of live nuclear bombs roaming around the Continent was becoming an increasingly sensitive issue. Then there were security aspects to think about: sabotage, accidents, visions of stray F-100s ending up on someone's front lawn.

But there was an alternative: You could hide the things away, store them in "hard sites"—bomb-proof bunkers that could be scattered along the perimeter of air bases, deep in forests, or off in tunnels. The airplane would fly from the same trailer, but it would be an "indoor" launch as opposed to an "outdoor" one.

On August 19, 1959, Blackburn made the world's first in-

door takeoff from New Mexico's Holloman Air Force Base. He loved it. "A smooth, slick, easy way to go," he says.

At that point, he recalls, "We said the only thing we haven't done, other than launch in a blinding blizzard, is to do one at night. So I did that too."

And finally there was nothing more to prove.

Later that year, Blackburn went around the country giving briefings to various Air Force higher-ups. He made a tour of Europe, presenting the ZEL story to the military commanders of England, Denmark, the Netherlands, Germany, France, and Italy. Everyone agreed that this was a great notion, entirely workable, with no show-stoppers in sight. More than a hundred F-100s incorporating provisions for zero-length launch were actually built, and then...

Nothing happened.

Every few years after the second cancellation of the ZEL program, Blackburn would be called to the Pentagon to tell them all about it once again. People would listen polite-

Before North American's flight tests, a Republic F-84G Thunderjet flew a series of trials, landing on a rubber mat.



ly, nod their heads, and say it was all very interesting. And still nothing would happen.

In the early 1960s, the concept was trotted out and tested yet again, this time with Lockheed F-104 Starfighters, which began lifting off smartly from launchers just as the F-84s and F-100s had done. These new tests were sponsored by the Luftwaffe, which had a bunch of F-104Gs on hand. But once again no hard sites were built and no nuke-laden fighters were driven hither and yon around the countryside.

Everyone involved has a theory about why the whole thing fizzled. Bob Titus says, "I'm sure the commander in Europe said, 'Look, there's no way I can provide security for these

aircraft if we stick them out in the woods. And maintaining them—and maintaining my training schedule—that can't be satisfied with planes in hard sites.'"

"The issue was whether it was really needed," says George Rodney, "especially when you have a modern extended-range fighter with drop tanks, which can go quite a distance. And it was fairly expensive—it took a rather large bottle, the solid rocket motor. Anyway, the tactical need for it never materialized."

Al Blackburn says, "The security requirements for it—to have enough security personnel, plus all the cooks and bakers that you'd need to feed them—that took more people than they had in Germany. That's what killed the concept."

Whatever the reason, the zero-length launch was abandoned until the Marines solved the runway problem with an airplane called the Harrier. The now famous vertical-takeoff "jump jet" even eliminates the need for the rocket booster and the flatbed trailer.

George Rodney is retired in Florida. Bob Titus spends much of his time skiing at Snowmass, Colorado. Al Blackburn runs an aviation consulting firm, flies sailplanes, and has plans for a nonstop flight around the world—solo. This would top Voyager's nonstop flight with two souls aboard. And the Voyager had a lift-to-drag ratio of something like 28 to 1; Blackburn has a glider with a ratio of 57 to 1. His current idea is to glue two of them together, put an extremely fuel-efficient engine on the result, and head east.

"I could go around the world in five days and burn 1,500 pounds of fuel," he says. "I'm serious. You're going to have the best meteorological people in the world, you're going to fly at the right altitude, you're going to go from west to east, not the other way, you're going with the high winds. They guarantee me a 100-knot tailwind all the way."

A world record. Easy. Nothing to it. "It's going to be on autopilot, for God's sake," says Blackburn. "All you got to do is sit there and sleep." →

When ZEL was the focus of one episode of the TV show "Steve Canyon," Blackburn served as technical advisor on location (below). After the mobile launcher idea was shelved, aircraft were launched from fixed shelters (bottom).



COURTESY AL BLACKBURN



ROCKWELL INTERNATIONAL

YOU'VE
READ IT...

RUNWAYS OF FIRE

NOW
WATCH IT!

If you like the story you just read, imagine watching it unfold before your eyes in **RUNWAYS OF FIRE** —The Video. Featuring historic footage with contemporary production and analysis, this just-completed family video will provide hours of entertainment for aviation enthusiasts.



The
Video!



- Be there as bewildered engineers watch a test "iron bird" tumble through the sky and smash into the desert sand!
- Watch as a booster rocket refuses to jettison, making it impossible for the Super Sabre to land!
- See the triumphant conclusion of the entire series of flights, one of the most exciting experimental test flying programs in the history of aviation!

Just produced, this collectors-edition of **RUNWAYS OF FIRE** —The Video may be ordered for only \$14.95 plus \$5 for shipping and handling.

Quantities are
definitely
limited. So
order now to
guarantee
delivery in
time for the
holiday
season!

For fastest service, phone 1-800-824-5974 toll-free to leave a recorded message with credit card information. You can fax credit card information to: 202-287-3163.

OR SEND MAIL ORDER TO: Air & Space/Smithsonian, 901 D Street, SW, 10th Floor, Item #ROF1, Washington, DC 20024.

☐ one Runways of Fire video @ \$19.95 (incl. S&H)

☐ two Runways of Fire videos @ \$39.90 (incl. S&H)

☐ This video order is for use as a 1995 holiday gift, please rush.

☐ Check or money order enclosed

Make check payable to: Air & Space/Smithsonian

☐ Discover

☐ Mastercard

☐ American Express

☐ VISA

Acct. # _____

Exp. Date _____

Signature _____

MAILING ADDRESS (PLEASE PRINT):

Name _____

Address _____

City _____

State _____

Zip _____

Please allow up to 4 weeks for delivery.





>SIGHTINGS<



ERIC LONG (2)

For proof that small is beautiful, take a look at *On Miniature Wings: Model Aircraft of the National Air and Space Museum* (Thomasson-Grant), a new book by curator Thomas J. Dietz. Among the models pictured, the one-eighth scale Fokker D.VII at left is a veritable giant, with a wingspan of 58 inches. Constructed by William F. Goze and acquired by the Museum in 1982, it has a wood-and-metal framework and fabric covering. The aluminum Northrop Gamma in the background at top was built by the Hughes Tool Company at the Smithsonian's request after Howard Hughes set a transcontinental speed record with a Gamma in 1936.

Below, the book's photographer, Eric Long, prepares a subject—a one-sixteenth scale wooden X-15—for a shoot.

MARK AVINO/NASA



>SIGHTINGS<



Museum visitors can find the diorama above in the Pioneers of Flight gallery, next to one of the real Douglas World Cruisers, the *Chicago*. Modeler Jamie Pie depicted the airplanes from the first round-the-world flight at a refueling stop in Seward, Alaska.

The subject at right is more than just a still life: it was the first radio-controlled helicopter to fly successfully. Built by David Gray, it was first demonstrated publicly in 1970.

"If, as the saying goes, God is in the details, then modeling is truly a heavenly craft," writes Dietz. Amen.



YOU DON'T HAVE TO BE A ROCKET SCIENTIST

TO GET THE RIGHT INFORMATION AT THE RIGHT TIME.

THE AVIATION WEEK GROUP FROM MCGRAW-HILL is now online on CompuServe providing you with the most comprehensive source of aviation and aerospace information.

THE AWG INFORMATION CENTER delivers the latest in aviation news, photos, and feature articles from *Aviation Week & Space Technology*, *Business & Commercial Aviation*, *A/C Flyer*, *Aviation Daily*, and all the AWG publications.

EACH WEEK, YOU CAN review the latest aviation news, look up archived articles and test-pilot reports, download photos, and read on-the-spot reports from the world's leading airshows.

IN ADDITION TO TIMELY INFORMATION, special interest areas rich in graphics keep you up-to-date on flight simulation and training, cockpit resource management, air safety investigations, plus global technology, business, and regulatory issues. And you can talk with the experts online in forums featuring AWG editors and other experts worldwide.

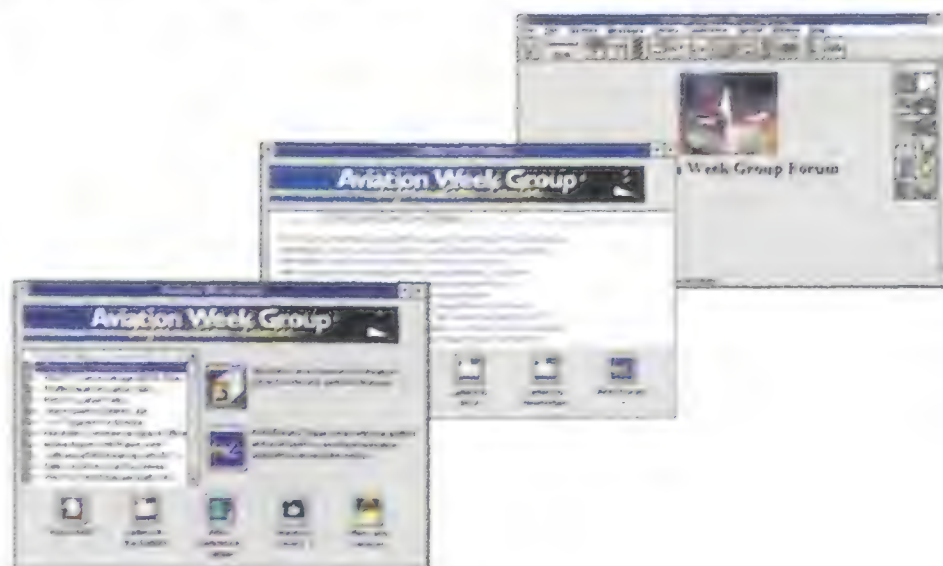
THE AWG INFORMATION CENTER is one of the thousands of information services and special interest groups available on CompuServe...including seamless access to the Internet.

THE INFORMATION IS INVALUABLE. THE SOFTWARE IS FREE.

You don't have to be a rocket scientist to get the best in aviation information. It's always available on CompuServe. If you're already a member, "GO AWG." If you would like a FREE copy of the Aviation Week Group software, just call and ask for the AWG representative.

CALL 1-800-591-9741

AWG ONLINE. ON COMPUERVE.



AVIATION WEEK GROUP

CompuServe is a registered trademark of CompuServe, Inc.

Will Worlds Collide?



Rogue Asteroids and Doomsday Comets: The Search for the Million Megaton Menace That Threatens the Earth by Duncan Steel (foreword by Arthur C. Clarke). John Wiley & Sons, 1995. 308 pp., b&w photos, \$24.95 (hardcover).

A host of books about the threat posed by comets and asteroids is about to descend upon an unsuspecting public, no doubt stimulated by Jupiter's experience with Comet Shoemaker-Levy 9 in July 1994. Duncan Steel's comprehensive overview of the menace posed to life on Earth arrives in the vanguard and is likely to stir passionate response. Steel, who hunts asteroids in the southern skies from Australia, takes the threat of a global impact catastrophe very seriously. His book is a treasure trove of numbers and calculations regarding comet and asteroid sizes, populations, impact energies, and collision probabilities. While the numerical details may inspire more amateur astronomers to search for rogue asteroids, they are likely to overwhelm the casual reader.

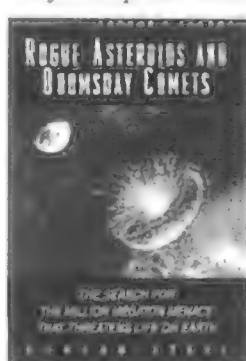
Steel also includes an elegant summary of "coherent catastrophism," the theory that cosmic impacts occur in bursts rather than as isolated events, due to a swarm of comet and asteroid fragments called the Taurid Complex, the remnants of the breakup of a giant comet about 20,000 years ago. Hints of past impacts suggest that Earth moves into and out of the main band of the complex over periods of



Radar images show asteroid 4179 Toutatis, which came within 2.5 million miles of Earth in December 1992. The crater in the image above is approximately 800 yards across.

millennia. This leads Steel to suggest that the construction of the original Stonehenge, around 3,000 B.C., was inspired by the awe and fear aroused by repeated impacts of objects from the Taurid Complex. A millennium later, when Earth's orbit no longer intersected the Taurid Complex, the builders of Stonehenge II used the original's foundations to construct the now well-known, sun-oriented stone circles. His hypothesis is likely to infuriate those who believe that the skies were as quiet in ancient times as they are today, without a surfeit of objects smashing into the planet.

Steel also offers fascinating inside views of the planning meetings of Project Spaceguard, a NASA program to study ways to protect Earth, perhaps under a



technological umbrella inspired by the Strategic Defense Initiative. His overview reminds us that big projects imply big bucks, and that when money talks, rationality sometimes leaves the room. Whether our



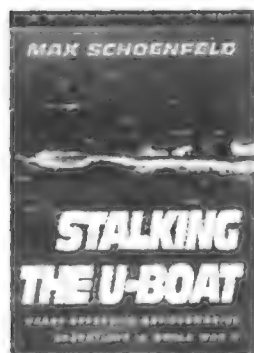
species manages to avoid a global impact catastrophe may depend on how we deal with facts rather than fantasies, and his book is filled with the former. Steel offers enough to enable readers to make up their own minds about the nature of the cosmic impact threat.

—Gerrit Verschuur, a radio astronomer and freelance writer, is currently writing a book about the threat of comets and asteroids.

Stalking the U-Boat: USAAF Offensive Antisubmarine Operations in World War II by Max Schoenfeld. Smithsonian Institution Press, 1995. 231 pp., b&w photos, \$37.50 (hardcover).

In the first year and a half of World War II, the U.S. Navy did not encourage offensive antisubmarine warfare. It wanted to get ships through, not go after the hunters. The U.S. Army Air Forces, on the other hand, wanted to hunt U-boats down before they struck. Convoy escort was not a high priority.

Between November 1942 and September 1943 the USAAF found a target-rich environment for offensive "strategic" aerial ASW. The 479th and the



480th antisubmarine groups were deployed to England to support the Royal Air Force offensive against U-boats crossing the Bay of Biscay. The two groups accounted for only 15 percent of the USAAF Antisubmarine

Command's operational flying time but 71 percent of its attacks. In the spring of 1943, when German admiral Karl Dönitz withdrew from the North Atlantic to operate southwest of the Azores, the 480th moved to Morocco to cover the western Spanish coast. The 480th sank a total of five boats, and the 479th participated in five other sinkings. Their offensive presence, like the much greater RAF effort, delayed U-boats, shortening their time on the convoy lanes.

In his detailed account of U.S. operations, a volume in the Smithsonian Studies in Aviation History series, Schoenfeld does not set these events in the broader battle of the Atlantic. He does not discuss the debate about the most appropriate and practical form of ASW. He says nothing of how much and in what ways the RAF Coastal Command cooperated with the U.S. groups, for whose assistance it had so forcefully appealed. Unasked and unanswered is whether the RAF shared crucial Ultra intelligence Britain had gained by cracking German codes.

Schoenfeld does, however, make the point that ASW was but a stepchild of a more ambitious USAAF concentration on strategic bombing of land targets. With that aim, which was part of a drive to become an independent air service, the USAAF eventually found it opportune to surrender its ASW mission to the Navy. Ironically, after the war, it was the Navy that revived as its own the mission of attacking "at the source" in order to save its carrier air force. With no targets at sea, offensive strategic bombing became Navy orthodoxy as well.

—George Baer is chairman of the Department of Strategy and Policy at the Naval War College in Newport, Rhode Island.

The Pre-Astronauts: Manned Ballooning on the Threshold of Space by Craig Ryan. Naval Institute Press, 1995. 344 pp., b&w photos, \$29.95 (hardcover).

High-altitude ballooning has never struck me as terribly exciting. Of course there is beauty in the sight of a huge, jellyfish-like bladder full of helium rising into a lightening sky, and the organism—monkey, dog, human—in the gondola



Complete 2-Year Set of SHORTEST U.S. DOLLAR SERIES SINCE 1795!

The only Dollar series with a shorter life than the Susan B. Anthony Dollar was the 1794-95 Flowing Hair—America's 1st Dollar!

The Anthony Dollar was released into general circulation for only two years—1979 & '80. (In 1981 they were available only in Mint Sets.)

With this special offer you get all 6 regular issue Susan B. Anthony Dollars for only \$10! One mint Uncirculated coin from each of the 3 Mints (Philadelphia, San Francisco, Denver) which struck them in both years (1979 & '80)—an \$18.95 regular retail value!

Ridiculed by the public as the "Carter Quarter" the mini dollar is fast becoming a *prized collectible*. Hard to put together now, a Complete 2-Year Set will get even harder. Clip the coupon below and send today! You'll also receive our free fully illustrated catalog, plus other offers on approval. Satisfaction guaranteed or your money back. DON'T DELAY! (Limit 4 sets.)

Littleton Coin Company, Dept. LH0317, Littleton, NH 03561

Celebrating Over 50 Years of Friendly Service to Collectors

☐ **YES!** Please send me the Susan B. Anthony six-coin 1979 & 1980 All-Mint Set at the low introductory price of **\$10** per set. (Regularly \$18.95 - Limit 4)

Send coupon with payment to:

Littleton Coin Company

Dept. LH0317

Littleton, NH 03561

No. of sets (limit 4) _____ x \$10.00 per set = \$ _____

Shipping & Handling \$ **1.00**

Total enclosed \$ _____

☐ Check or money order enclosed

Mr./Mrs./Ms. _____

Charge to my: ☐ VISA ☐ MC

Address _____

☐ AMEX ☐ Discover

City _____

State _____ ZIP _____

Exp. Date _____ / _____

Full 45-Day Money Back Guarantee of Satisfaction

Presenting...

The DR® FIELD and BRUSH MOWER

-- the amazing walk-behind
mower/brushcutter that--

• **CLEARs & MAINTAINS** meadows, pastures, roadsides, fences, wooded and rough non-lawn areas with ease. Mows over 1/2 acre per hour!

• **CUTS** tall grass, weeds, brush, brambles, sumac - even tough saplings up to 1" thick!

• **Plus CHOPS and MULCHES** most everything it cuts; leaves NO TANGLE of material to trip over or to pick up like hand-held brushcutters and sicklebar mowers.

• **POWERFUL 8HP** Briggs & Stratton engine; optional Electric-Starting. **BIG 20" SELF-PROPELLED WHEELS** roll through ditches, furrows, over bumps and logs with ease.



WHY MESS

with hand-held brushcutters that are so dangerous, slow and tiring to use... OR with sicklebar mowers that shake unmercifully and leave such a tangled mess?



CALL TOLL FREE
1(800)544-7878

Please write or call
TODAY for complete
FREE DETAILS of the
Amazing DR® FIELD
and BRUSH MOWER!

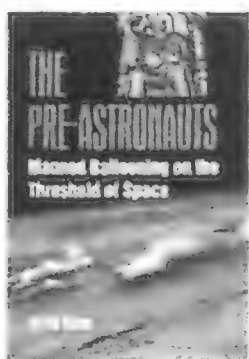
YES! Please rush complete **FREE DETAILS** of the DR® FIELD and BRUSH MOWER including prices, specifications of Manual and ELECTRIC-STARTING models, and "Off-Season" Savings now in effect!

City _____ State _____ ZIP _____

TO: COUNTRY HOME PRODUCTS*, Dept. 853F
Ferry Road, Box 89, Charlotte, VT 05445

GSA # GS07F-5372A

MADE IN USA



faces some hazards up where pressure is so low that dissolved gases in the blood begin to boil and exposure to the outside is fatally chilling. But the act of ballooning always seemed to me just further proof that what goes up must come down.

Given the bad attitude, I was surprised to be moved to high, vicarious anxiety by Craig Ryan's *The Pre-Astronauts*, a comprehensive look at America's high-altitude ballooning programs after World War II. One remembers many of the players: John Paul Stapp, the rocket-sledding flight surgeon and crash dummy who rewrote the book on the effects of deceleration while at Holloman Air Force Base in New Mexico, as well as such pioneer balloonists as the Mongolfier brothers and the famously eccentric Piccards. But most of the actors are Air Force or Navy, inexplicably drawn to a line of work that promises high risk, near-total obscurity, and no fortune at all.

As history, *The Pre-Astronauts* is a

Curator's Choice

The Norton History of Astronomy and Cosmology by John D. North. Norton, 1994. 697 pp., b&w photos, \$35.00 (hardcover), \$18.95 (paperback).

Why send spacecraft into orbit and into the farthest regions of the solar system to study astronomical bodies? John North's beautifully written overview of humanity's attempts to understand the nature of the physical universe provides a long perspective on this and many other fascinating questions. Ranging from Stonehenge to the Hubble Space Telescope, North's account is by far the best single-volume history of astronomy and cosmology available.

—Robert W. Smith is a historian in the National Air and Space Museum's department of space history.

thorough rendering of ballooning (what goes up) and the attendant parachuting from high altitudes (must come down) in projects with names like Manhigh,

Skyhook, Helios, Strato-Lab, and Excelsior. Himself a parachutist, pilot, and technical writer, Ryan adroitly braids the many strands of balloon-borne research and documents how it was surpassed by the space program, which evidently ignored the balloonists' observations at the edge of the void.

The experiences he describes turn what would have been a fairly interesting account of government research into a riveting read. While never the canny up-close-and-personal reporting of *The Right Stuff*, Ryan's book is often very compelling. Sharing the plummeting 1927 descent of Captain Hawthorne Gray or the ups and downs of the determinedly scientific David Simons, fearless Joseph Kittinger, and the refractory Clifton McClure (whose body temperature in his stifling gondola soared to 108.5 degrees on his flight), readers will find there is no putting down *The Pre-Astronauts*. One watches helplessly as Nicholas Piantanida rises to his sad stratospheric fate, and when Joe Kittinger bails out of an open gondola at 103,000 feet—well, you just have to go with him.

—Carl Posey, a frequent contributor to Air & Space/Smithsonian, wrote "Ozone Forecast: Partly Cloudy" for the Oct./Nov. 1994 issue.

Are You Dreaming of Building Your Own Aircraft?



Subscribe to KITPLANES magazine and make your dream come true. Join the many thousands of enthusiasts who are successfully planning, building and flying their own personal aircraft of their dreams. KITPLANES magazine will show you how easy it is to participate in the most exciting segment of general aviation in the 1990s: **homebuilt aircraft**.



- Discover the newest developments in experimental aircraft.
- Learn how expert builders do their best work.
- Experience the feel of flying in the fastest, slowest, biggest and smallest homebuilt aircraft.
- Get the latest on new materials, new designs and new techniques.

Subscribe to the hottest magazine in the homebuilt aircraft field!

For Faster Service Call: 1-800-735-9335

KITPLANES

YES, send me 12 monthly issues of KITPLANES for only \$19.97. *I save over \$22 off the cover price.*

☐ Payment enclosed

☐ Credit card

☐ Bill me (U.S. and Canada only)

(Canada add \$8 per year postage, plus 7% GST; Foreign add \$16 per year for surface mail or \$28 per year air delivery. Int'l money order, please.)

Name

Address

City

State/Zip

Account #

Signature

☐ Visa ☐ MasterCard

Exp. Date

Mail order form and payment to: KITPLANES Subscription Dept., P.O. Box 420235, Palm Coast, FL 32142-0235

Allow 6 to 8 weeks for delivery. K510AS

The Greatest Adventure: Stories and Photographs by Men and Women Who Have Flown in Space, ed. by Edward Gibson (foreword by James A. Michener). Pierson (Publishers Group West, 4065 Hollis, Emeryville, CA 94608, 800-788-3123), 1995. 224 pp., color photos, \$39.95.

A picture may be worth a thousand words, but pictures taken from space can only be enhanced by the stories of those who took them. That is the rich combination offered in *The Greatest Adventure*, a handsome coffee table collection of words and photographs from astronauts and cosmonauts. The images include stunning color views of orbital sunsets, Earth panoramas, spacewalks, and onboard activities. While some of the pictures have been seen before, like those from the Apollo moon missions, I found a number that were unfamiliar. Especially beautiful is a telephoto view of the crescent moon and Jupiter floating in blackness above a rainbow-hued sunset.

But what really distinguishes this book are the accompanying essays, written by the space veterans. Full of candid thoughts and recollections, they give accounts of close calls (such as the aborted launch of a Soyuz mission in 1975) and of the elation and disappointment that came with success and failure. And there are moments of awestruck poetry, such as space shuttle astronaut-astronomer Jeff Hoffman's description of flying through Earth's shadow. During one moonless orbital night, he recalls, "All I could see were the stars and the entire universe surrounding us. The Sun was gone and the Earth seemed far away. It was incredibly lonely."

—Andrew Chaikin is the author of *A Man on the Moon: The Voyages of the Apollo Astronauts*, recently published in paperback by Penguin.

Crommelin's Thunderbirds: Air Group 12 Strikes the Heart of Japan by Roy W. Bruce and Charles R. Leonard (foreword by Admiral Frederick H. Michaelis). Naval Institute Press, 1994. 228 pp., b&w photos, \$26.95 (hardcover).

Charlie Crommelin, one of four wartime naval aviator (and one non-aviator)

brothers, brilliantly led two carrier air groups during the Central Pacific offensive of World War II. His first tour, as skipper of Fighting Squadron 5 and then of Air Group 5 aboard the new *Yorktown* in 1943, was



The Greatest Adventure of the 20th Century

A definitive interactive history of the Apollo Project on CD-ROM

- Hundreds of full color photographs
- Over an hour of historical video
- Interactive Time Lines & Diagrams
- Summaries of Every Mission
- Biographies of Every Astronaut

(Windows '95 Version Available Winter 1995)

Price: \$59

Imagination Software, Inc.
10497 Town & Country Way #850
Houston, TX 77024 (713) 973-0456

imagine@neosoft.com
<http://www.neosoft.com/~imagine>

StairMaster Health Club Quality... Now For Your Home Gym!



The ORIGINAL Stepper from StairMaster!

- **FAST, EFFICIENT WORKOUT** strengthens and conditions heart and major muscle groups in as little as 15 minutes a day!
- **#1 IN HEALTH CLUBS** - enjoy the same unique "feel" of StairMaster's patented, independent step action at home!
- **SAFE AND EFFECTIVE** for all ages and fitness levels - trusted by over 1,700 medical facilities throughout the U.S.
- **CONTINUOUS AND ACCURATE FEEDBACK** from computer console acts as your personal trainer to monitor progress and evaluate results!
- **NOW AVAILABLE FACTORY-DIRECT** at just \$2,195 plus shipping and applicable sales tax.

Call Today for a Free Catalog and Video or to Order!

CALL 1-800-666-9936 DEPT. 38

StairMaster Sports Medical Products, L.P. 72421 Willess Road N.E., Suite 100, Kirkland, WA 98034

©1995 StairMaster Sports Medical Products, L.P.

Enter the World of the Airline Pilot

Read *Air Line Pilot* magazine, the pilot's journal, offering in-depth articles on their jobs, their environment, and their lives.

AIR LINE PILOT

Call 1-800-253-7916 now to subscribe (\$24/year) and receive an extra issue free!

Published by the Air Line Pilots Association, International.

REVIEWS&PREVIEWS

cut short when he suffered severe wounds from anti-aircraft fire that hit his F6F Hellcat cockpit and impaired his vision. Months later, he wrangled command of Air Group 12 and was allowed to work it up as a complete group instead of as separate fighting, bombing, and torpedo squadrons merely coming together just prior to deployment. Thus ensuring teamwork, he took his "Thunderbirds" aboard the *Randolph* in 1945 for the first sustained carrier strikes

VIDEO

Lindbergh's Great Race, *Discovery Channel*, November 9 and 12 (original 90-minute version, "Are There Any Mechanics Here?" available for \$34.95 from The Charles A. Lindbergh House, 1200 Lindbergh Dr. South, Little Falls, MN 56345).

An award-winning documentary about the rush to claim the Orteig Prize, offered in 1919 to the first aviator to fly nonstop between New York and Paris, "Lindbergh's Great Race" incorporates rare newsreel footage of Lindbergh and his competitors. Though Lindbergh's 1927 New York-to-Paris solo flight is an oft-told story, filmmaker Cameron Richardson sprinkles his narration with little-known factoids, guaranteeing that even ardent aviation enthusiasts will come away with something new.

Apollo 13: The Untold Story. *Whitestar*, a division of *Kultur* (195 Hgwy. 36, West Long Branch, NJ 07764; 1-800-458-5887). 50 minutes, \$19.95.

As an adjunct to Ron Howard's smash hit *Apollo 13*, this video provides plenty of details the movie did not include: how the oxygen tank was damaged before the flight, what computations were made to get the spacecraft home, how the electrical system was powered up. The stories are told by the heads of mission control crash teams under Gene Krantz's direction, and you come to realize that Apollo 13 was actually NASA's greatest triumph, thanks to the furiously scribbling young engineers in horn rims.

—Patricia Trenner is departments editor at *Air & Space*/Smithsonian.

FLY A FIGHTER

You've seen us on ABC "20/20" and the cover of "Flying".

With the Olympics coming to Atlanta, now is the time to book your air combat adventure with the world famous Sky Warriors.

You'll be at the controls of a laser-gun and video equipped T-34. No pilot's license needed—a USAF, Navy or Marine fighter pilot guides you through every maneuver.



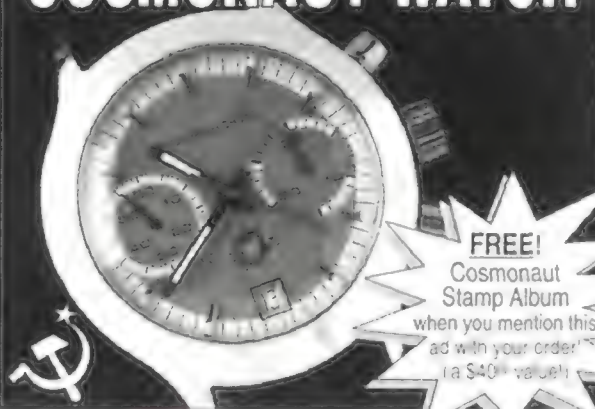
Atlanta, GA USA
1 800 759-2160

Internet: <http://skywarriors.com>

Call now for Christmas gift certificates and corporate hospitality opportunities.

All for only \$695!

AUTHENTIC SOVIET COSMONAUT WATCH



FREE!
Cosmonaut
Stamp Album
when you mention this
ad with your order!
(a \$40 value)

Now, you can own the original Shurmanskiye (Russian for "navigator") watch, identical to the model worn by Soviet Cosmonaut Yuri Gagarin when he blasted off on the world's first manned space flight in 1961. Tough enough to withstand the rigors of space travel, this stainless steel, chronograph style watch is loaded with features: 23-jewel movement, two inset stopwatches, date window, luminous hands and indices. Each watch engraved with unique serial number and includes handsome, black leather strap, gift box and one-year warranty. Money Back If Not Satisfied! Sensational price of only \$199⁹⁵*

Hurry, Comrade,
Quantities
Limited!

CALL NOW!

800-442-0002

Sovietski™ Collection
San Diego, CA

* Plus \$4.95 for shipping & handling. Price includes original Russian factory documents & English instructions

against the Japanese homeland and the Iwo Jima and Okinawa operations—the subject of this action-packed book.

Unfortunately for him and his group, Crommelin was transferred mid-tour to Admiral J.J. “Jocko” Clark’s flagship, the new *Hornet*, to fly as target coordinator, only to perish in a mid-air collision with his wingman. This book reveals that, whenever necessary, his Thunderbirds acted as his eyes; without the group, his old wound probably caused his fatal miscue. The authors, both Hellcat jockeys in Air Group 12, have pieced together its combat record from action reports, in-house squadron histories, recent recollections of comrades (including “Mike” Michaelis, the Fighting 12 skipper who wrote the foreword), and one diary, kept by a *Randolph* surgeon.

The author-veterans succeed admirably in capturing the flavor of the Navy’s round-the-clock carrier combat operations in the final Pacific campaigns: Task Force 58’s first attacks on Tokyo, aerial interdiction of the kamikazes, air-sea rescues, downed pilots’ experiences in Japanese prison camps, and the flak-riddled missions providing close air support for the Army at Okinawa. We learn of the first use of G-suits in the Pacific and the vagaries of carrier night-fighter activities.

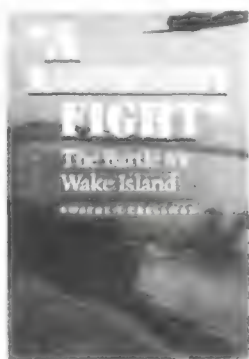
The writers quote too much from the

action reports; by consulting other books about Crommelin and the 1945 campaign they could have avoided niggling errors and omissions. Yet all in all, *Crommelin’s Thunderbirds* sets a solid precedent as the first book ever written about a U.S. Navy carrier air group during World War II.

—Clark G. Reynolds’ most recent book is *The Fast Carriers* (Naval Institute Press, 1992).

A Magnificent Fight: The Battle for Wake Island by Robert J. Cressman. Naval Institute Press, 1995. 324 pp., b&w photos, \$29.95 (hardcover).

On the opening day of the Pacific war, Wake was bombed and strafed by island-based airplanes of the Japanese navy. The raiders left seven Grumman F4F Wildcats wrecked on the ground.



With five remaining fighters, U.S. Marine Corps pilots defended the atoll for two desperate weeks. They shot down two Mitsubishi G3M land-based bombers, two Nakajima B5N carrier bombers, and a

Kawanishi flying boat, and sank a destroyer with gear intended for water-filled practice bombs. They cannibalized wrecked Wildcats and refilled oxygen bottles from tanks belonging to the welders who had been building the island defenses. And when their last Wildcat was shot down, they took up rifles and fought as infantrymen.

The defense of Wake is an old story, but Cressman freshens the telling with Japanese accounts. He can get carried away with nomenclature—writing “a shotai of three kansen” instead of “a flight of three Zeros”—but in battle after battle he identifies the pilots in opposing aircraft and confirms or denies 54-year-old victory claims.

A relief force was dispatched from Hawaii, built around the carrier *Saratoga* and its two fighter squadrons, including 14 Brewster F2A Buffaloes that were to land on Wake on Christmas Eve and replace the lost Wildcats. The Japanese got there first, and the Americans turned away without launching an airplane or firing a shot. As was so often the case in the winter of 1941-42, the United States was a day late and a carrier short.

—Contributing editor Daniel Ford has a special interest in Japanese-American aerial warfare.

Experience The Adventure of Flying With Private Pilot



Subscribe to PRIVATE PILOT and re-discover the excitement of flying. From taildraggers to jets, PRIVATE PILOT flies them all. Join us on excursions to exotic locations like Alaska’s glaciers, the Grand Canyon, and Catalina Island. You’ll also explore ways to fly for less money; how to buy and finance your plane; plus, best-buy recommendations to fit your budget. All this and more in the pages of PRIVATE PILOT.

Subscribe TODAY!

PrivatePilot ☒ **YES**, send me 12 monthly issues of PRIVATE PILOT for only \$11.99. *I save over \$23 off the cover price.*

Name

Address

City

State/Zip

- ☐ Payment enclosed
☐ Credit card
☐ Bill me (U.S. and Canada only)
(Canada add \$8 per year postage, plus 7% GST; Foreign add \$16 per year for surface mail or \$28 per year air delivery. Int’l money order, please.)

☐ Visa ☐ MasterCard

Account #

Exp. Date

Signature

Mail order form and payment to: **PRIVATE PILOT** Subscription Dept., P.O. Box 55064, Boulder, CO 80322-5064

Allow 6 to 8 weeks for delivery to begin.

For Faster Service Call: **1-800-365-4421**

FIGHTER PILOT FOR A DAY

**YOU FLY
AIR COMBAT!**
No Flight Experience
Required!

- ★ FLIGHT GEAR
- ★ BRIEFING
- ★ FORMATION FLYING
- ★ AERIAL DOGFIGHTS
- ★ VIDEOTAPE OF FLIGHT

\$695⁰⁰

This is NOT a Simulator
FLIGHTS AVAILABLE
AT AN AIRPORT NEAR YOU!

WORLD FAMOUS  **AIR COMBAT U.S.A., INC.**

 **(800) 522-7590** 

*The Stokes Collection
Limited Editions*



The fabulous life-like images of award winning aviation artist Stan Stokes are yours to enjoy. Lithographs and reproductions on canvas are now available. Please write or call us toll free for our **FREE COLOR CATALOG**. Our 100% money back guarantee assures your complete satisfaction. Dealer inquiries Invited.



Box 1420, Pebble Beach CA 93953
1-800-359-4644

**A NATIONAL TREASURE.
A PERSONAL ADVENTURE.**

An exclusive look at the Smithsonian's spectacular collection of model air and spacecraft.



ON MINIATURE WINGS
Model Aircraft of the National Air and Space Museum
Text by Thomas Dietz. Preface by C.D.B. Bryan

ISBN 1-56566-085-4 HARDCOVER, \$34.95
ISBN 1-56566-086-2 SOFTCOVER \$19.95 • 11" X 11"
180 PAGES • 150 FULL-COLOR PHOTOGRAPHS

THOMASSON-GRANT

Available through your local bookstore, or call
(800) 999-1780

Celebrate July 4th & All Events
CARBIDE CANNON
BIG BANG! **\$119.95**



Mammoth Cannons shoot with terrific BANG! Have a bang-up time at special events. Uses powdered carbide ammo. Hundreds of shots for few cents. All metal construction with large, rugged cast-iron wheels. Machined brass mechanism for easy loading and firing. Authentic turn-of-century design. Handsome decor when not in use. Made in USA to last a lifetime. Available in 3 sizes: 9" cannon, \$49.95 postpaid; 17" cannon, \$89.95 postpaid; 25" cannon (shown here) with rapid firing and automatic loading, \$119.95 postpaid. The larger the cannon the louder the bang! Carbide ammo, about 100 shots, \$6.00; 3 packs for \$15.00. Send check, money order or call. Visa, MasterCard accepted by mail or phone. Give card number & expiration. Money-back guarantee. Send for **FREE CATALOG!**

The Conestoga Co., Inc., Dept A, PO Box 405, Bethlehem, PA 18016
★★ Call 1-800-987-BANG (2264) ★★

Bargain Books

FREE CATALOG offers thousands of publishers' overstocks, remainders, imports and reprints. **SAVE UP TO 80%** on yesterday's best sellers to titles you never knew existed. Over 40 subject areas: **Science and Aviation**, Military and American History, Biography, Sports, Politics, Fiction, Arts & Crafts and more, starting at \$3.95. Write:

HAMILTON
Box 15-153, Falls Village CT 06031

CREDITS

On Lindbergh's Wing. Richard C. Kirkland flew 103 fighter missions in World War II and 69 helicopter missions in the Korean war. After leaving the Air Force, he was a demonstration pilot for Hughes and McDonnell Douglas. He hopes that his first novel, *Homesick Angel*, a story of early helicopter medical evacuations, will be published this year.

Poetic License. Tony Fitzpatrick is the author of *Signals From the Heartland* (Walker and Company, 1993), a book about Midwesterners and the environment. He writes about science, technology, and anything of interest within the solar system.

Encore for an SST. Tom Huntington is the managing editor of *Air & Space/Smithsonian*.
Further reading: *Soviet SST: The Technopolitics of the Tupolev-144*, Howard Moon, Orion Books, 1989.

The SSTs. Well-traveled illustrator John Batchelor specializes in military technology, and over the last 30 years he has produced thousands of color paintings, line drawings, and cutaways.

Homecoming. Stephan Wilkinson has been a pilot for 30 years and a freelance magazine writer for 20. He lives on Storm King Mountain in the Hudson River Valley and specializes in writing about aviation, automobiles, and adventure.
Further reading: *To Win the Winter Sky*, Danny S. Parker, Combined Books, 1994.

Illustrator Web Bryant is a Virginia Beach native who grew up near the Oceana Naval Air Station. "I'd draw F-4s and A-6s in the margins of my notebook," he says. "I could look out the windows of Kempsville Meadows Elementary School and watch them do touch-and-gos."

Astronomy's Hot Spot. Donald Goldsmith's latest book is *Einstein's Greatest Blunder: The Cosmological Constant and Other Fudge Factors in the Physics of the Universe* (Harvard, 1995).
Bipolar photographer Ann Hawthorne thaws out in Washington, D.C., and North Carolina between assignments. This is her third polar story for *Air & Space/Smithsonian*.

Passage to Vietnam. Henry Scammell is a frequent contributor to *Air & Space/Smithsonian*. His most recent article, "The Eagles Have Landed," appeared in June/July 1995.
Photographer Geoffrey Clifford was a

Air & Space October/November 1995



FLY THE LEGEND



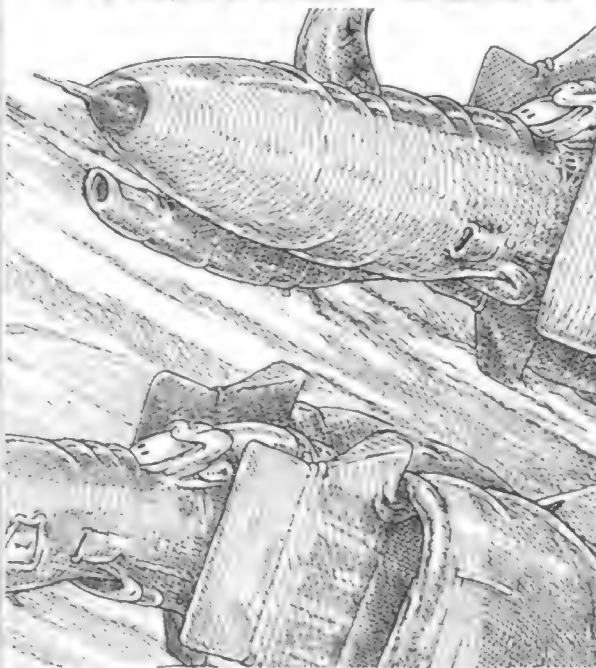
"Unless you have slammed full burner to a MiG-25 out of Zhukovsky Air Base, Moscow and popped out at 72,000 feet pushing 2.5 Mach, then you're not worthy." *(direct quote from someone worthy)*

Call today for a free brochure telling how you can fly the MiG-25, MiG-29, MiG-21 and more. Packages start at \$5500.

MIGS etc., Inc. • 800 MIGS ETC (USA)
813 923-0607 • fax 813 923-8815



HANK CARUSO'S 1996 AEROCATURES™ CALENDAR



The 1996 Aerocatures™ Calendar features: Blue Angels 50th Anniversary Fly-By; F-4E, RF-4, F-4D Pharewell; F/A-18 High Trap; Bird Strikes; S-3 & ES-3; T-34 Family; Cajun F-16, A-10, A-37; B-36 drops F-84 FiCon; RH-53 Desert Rescue; A-5 & RA-5C; C-46 & C-47 Fly the Hump; SH-3 to SH-60 Transition. Calendar size is ~8.5" x 11". Contents b&w, Blue Angels '50th' cover art in color. Includes bonus color Aerocatures™ suitable for framing: TBM Avenger Torpedo Run and F-105G Wild Weasel vs. SAMs.

Cost is \$12 per calendar + \$3 SHIPPING & HANDLING (U.S. and Canada) per order. Maryland residents add 5% SALES TAX. Prices for shipping outside the U.S. and Canada, quantity discounts (25 or more), and wholesale orders available on request. Not responsible for shipping damage. Sorry, but no cash, CODs, or credit cards. Non-U.S. orders: money orders only in U.S. dollars redeemable through U.S. agent. Calendar available late October 1995.

ForeFeathers™ Enterprises
7814 Solari Court, Dept. AS
Pasadena, MD 21122 USA

CALENDAR

a tour of a newly restored RB-36H. Castle Air Museum, Merced, CA, (619) 320-8988.

October 14 & 15

EAA Quad-Chapter Fly-In and Flea Market. Sussex Airport, Sussex, NJ, (201) 702-9719.

October 18-21

487th Bomb Group, Eighth Air Force Reunion. Orlando, FL. Contact Robert D. Hesse, 6308 Heather Lane, Pinellas Park, FL 34665.

October 21 & 22

Wings Over Houston Airshow Festival. Ellington Field, Houston, TX, 1-800-4-HOUSTON.

October 28

Airline Collectibles Show. Sheraton Riverhouse Hotel, Miami, FL, (305) 935-2922.

November 4 & 5

Skyfest. Thunderbirds and Shockwave Jet Truck. Daytona Beach International Airport, Daytona Beach, FL, (800) 854-1234.

Wings 'n Things 95. Lakeland Linder Regional Airport, Lakeland, FL, (813) 251-1820.

November 5

Behind the Scenes Tour. New England Air Museum, Windsor Locks, CT, (203) 623-3305.

November 8-12

Aviation History Seminar. National Museum of Naval Aviation, Pensacola, FL, (404) 231-0547.

THE
VERTICALLY
CHALLENGED
DIPPER



THE
DIPPER
POSSESSING AN
ALTERNATIVE BODY
IMAGE

11/2

Airplane! Airplane!

30 Minute Live-Action
Video for Kids of all Ages

"...the best videography
we've seen ..."

"A two-year old remained
enthralled...his parents agreed...
it was the best kid video to pass
through their VCR."

—Peter A. Bedell, AOPA Pilot magazine

Call 1-800-571-3725

\$19.95 Plus S&H \$3.95

TAG A LONG

PRODUCTIONS P.O. Box 784, Medford, NJ 08055

RUSSIAN SPACE POSTERS

- #1 The Russian Cosmonauts & Their Crews
 - #2 The Russian Rockets & Launch Vehicles
 - #3 The Russian Space Ships & Space Stations
- 3 Colorful Posters \$9.95. Int'l add \$5 Airmail

226 N. PRINCE ST., LANCASTER, PA 17603

Send \$3
for our new catalog

- Aircraft Nose Art
- WW II Aircraft
- Pilot & Aircrew Wings
- WW II Armor

Almost 300
Fine Rubber Stamps



ImaginAir Designs
1007 Woodland NW #5
Albuquerque New Mexico 87107

MILITARY PATCHES Catalog



Choose From 2800
Patches & Pins
Pictured in Color

Order Your Catalog Today!

Send \$4.50 (foreign \$8.50) post-paid to

BattleZone Ltd.

P.O. Box 266SA, Towaco, NJ 07082

(\$2.00 Rebate on 1st order)

1996 CALENDAR



APOLLO TO THE MOON

FULL-COLOR 1996 CALENDAR

12 months covering every Apollo mission from VII to XVII. Stunning photos. Order by mail or call toll-free with VISA/MC.

1-800-528-3493

9-6 (Eastern)
Mon. - Sat.

or send \$12.95 plus \$2.00 shipping/handling per calendar to A.D. Productions, 3407-H W. Wendover Ave., Greensboro NC 27407. NC residents add sales tax.

Ready to hang on wall. Supplies limited. Allow 4 weeks for delivery.

A1

"The Satellite Sky" Update/50

These regular updates to "The Satellite Sky" chart will enable readers to keep their charts up to date. Additions can be clipped and affixed to the chart at the appropriate altitude.

New launches

90 to 300 MILES

**Cosmos 2314**
6-28-95 PL

**Progress M-28**
7-20-95 TT


**Cosmos 2315**
7-5-95 PL


**Helios 1A**
7-7-95 KOU


**Cerise**
7-7-95 KOU


**Upmsat-1**
7-7-95 KOU

6,200 to 13,700 MILES

**Cosmos 2316-18**
7-24-95 TT

**DSCS III**
7-31-95 CAC

**DBS-3 (DTV)**
6-10-95 KOU

**TDRS-7**
7-13-95 KSC

21,750 to 22,370 MILES

Inoperative but still in orbit

21,750 to 22,370 MILES

SBS-3
Intelsat 5F1
Brazilsat-2
MOP-1
TV Sat-2
Raduga 26

DATA SATELLITES

Launched but not in orbit

90 to 300 MILES

STS-71 KSC	6-27-95	down 7-7-95
STS-70 KSC	7-13-95	down 7-22-95

Deletions

90 to 300 MILES

Cosmos 2258
down 6-8-95

Cosmos 2264
down 8-7-95

FORECAST

In the Wings...

Air Waves. If you could see the wind, the currents cascading down the leeward slopes of the world's mountains would make even the fiercest ocean waves look like ripples in a stream. Atmospheric scientists are trying to make sense of the chaos in downslope winds in order to rob it of its ability to bring down airplanes.

Astronauts on Parade. Not all the perilous journeys made by Mercury, Gemini, and Apollo celebrities took them into space.

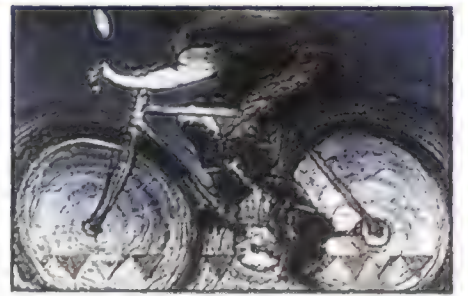
Russian Wingships. The first was a 350-foot-long, 540-ton monster that skimmed the Caspian Sea at 280 mph in 1966. Taking advantage of a drag-reducer known as ground effect, Russian engineers continue to develop winged craft that are faster than ships and potentially more efficient than airplanes.

Will Cars Ever Fly? Aerocar, Starcar, Autoplane, AviAuto, Skycar, Roadrunner, Advanced Flying Automobile: Many patents, a few prototypes, but no production. Yet.

Calling All Shoppers

True Art Collectors

"Hindsight", a multiple-plate colored etching capturing the adventurous spirit of biking by world renowned artist Larry Welo is now being offered. Authentic Limited edition...only 70 numbered prints available...Welo's works are sought after by collectors and world-class museums. Order now before this edition is sold out. \$460 includes shipping and handling. To order: Call toll free 1-800-772-3974 charge your credit card: Visa, MasterCard, Discover, Amex or send check or money order payable to: D&H Galleries, Inc., P.O. Box 312, Dept.363, Fairfield, IA 52556.



28 1/2" x 24 1/2", elegantly framed

Call or write today for FREE Print Catalog

All orders are filled on a first-come, first-serve basis



Running Out Of Expensive Disk Space

PKZIP can Help! PKZIP compresses your files to keep up disk space and reduce modem transfer time. You can compress a single file or entire directory structure with a single command. Compressed files can be quickly returned to their normal size with PKUNZIP. Software developers can reduce the number of diskettes needed to distribute their product by using PKZIP. Call for Distribution License information. To order call 414-354-8699 or write: PKWARE Inc., 9025 N. Deerwood Drive, Brown Deer, WI 53223.

FREE SCIENCE CATALOG

At Edmund Scientific, we specialize in providing over 5,000 scientific products and components in our new 'SCIENTIFICS' Catalog. 104 pages of hard-to-find science discovery items, solar and lab equipment, optics, lasers, microscopes, telescopes, magnets, magnifiers and weather instruments for science hobbyists and educators.

**Over 50 Years of Service**
Edmund Scientific
Dept. 1041 C-901 Enterprise Bldg. Barrington, NJ 08007
Phone 609-547-8880 Fax: 609-573-6295

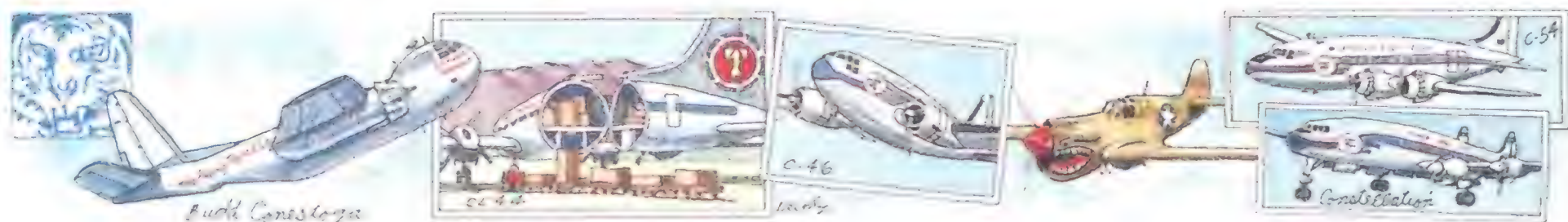
FREE CATALOG 609-547-8880



Tough Traveler® Deluxe Child Carriers



For wonderful hikes with your child. Tough Traveler® Child Carriers are known for Comfort, Safety Features, Convenience and Construction. Sold in Outdoor Specialty Stores, Baby Stores, and Mail Order. Made and designed in the USA. FREE Catalogue Fax: 518-377-5434. Or call 1-800-Go Tough.



JOHN HEINLY

The Other Flying Tigers

Strawberries, horses, chairs, grapes, gladioli, killer whales—the Flying Tiger Line moved them all. “We’ll fly anything, anywhere, anytime,” the airline’s motto boasted.

The Flying Tiger Line was the first all-cargo air service in the United States, but among the founders were men who were old hands at flying freight. During World War II, they had served in China with the first Flying Tigers—the legendary American Volunteer Group, organized by retired general Claire Chennault to fly shark-faced P-40s against the Japanese. When the Flying Tigers disbanded in 1942, many of the pilots joined the China National Aviation Corporation, which assigned them the job of flying the treacherous “Hump” of the Himalayas to ferry supplies in from India.

At the end of the war, Flying Tiger/CNAC pilot Robert Prescott got together 11 former co-workers to pool their talents and start an air cargo line in the States. Under Prescott’s direction, they scraped up \$89,000 plus outside backing and bought 14 Budd Conestogas—bulbous twin-engine Navy transports made by the company that built Pullman railroad cars. From these beginnings the Flying Tiger Line eventually grew into the free world’s largest air cargo line. Many of the early employees ended up staying 30 years or more. The story of their commitment is told in an intimate little museum in Los Angeles.

The collection was conceived in 1988, when Federal Express approached some of the original Tigers to see if they would sell their stock. Realizing that in the shuffle of a corporate takeover their company’s archives might be lost, half a dozen retired Tigers sprang into action.

They began by rescuing several containers filled with company records, photos, news clippings, film, and airplane models, which had been forgotten in a warehouse. According to 37-year Tiger veteran Jim Thomas (now Chairman of Memorabilia), “If we hadn’t got hold of it, in another month it would have been in the trash.” After Federal Express acquired

the Tiger line in 1989, it provided space in its flight training center for the collection.

Under the direction of Joe Baker, who had managed Tiger equipment and facilities for 33 years, the Flying Tiger museum grew the same way the Flying Tiger Line had grown—everyone pitched in. Once word got around, retirees began rummaging through attics and desk drawers and the backs of closets, bringing out aircraft models, uniform patches, service awards, and commemorative plaques. Today the museum includes a

Joe Baker Museum of Flying Tiger History, 7401 World Way West, Los Angeles, CA 90045. Phone (310) 649-8752. Open Wednesdays, 11 a.m.–2 p.m., except for the first Wednesday of the month. Appointments recommended.

golf club-turned-cane used by Robert Prescott, a doll in a Flying Tigers stewardess outfit (the airline had provided charter passenger service), and a display honoring the airline’s first telephone operator, Etta Baedeker, complete with her switchboard plugs. A cargo tag commemorates the company’s first shipment of strawberries. The 1,300-pound load had to be flown from California to Georgia in a C-47 without air conditioning. Jim Thomas recalls the resourceful solution: “We got an AC/DC converter, turned it into an electric motor, connected the DC end to the engine generator, attached a fan, then blew it over a washtub full of dry ice. That was our air conditioner.”

Hundreds of photographs in the collection span the history of the Tiger line. One shows 101 calves loaded on a C-46 for a 1951 flight from Los Angeles to Enid, Oklahoma. Another, showing four Tiger employees bundled in parkas, brings back memories for one of the men pictured, chief engineer Chuck Steeves. In 1956, a Tiger C-54—a military version of the Douglas DC-4—flying freight to northern Canada had struck a pile of

frozen snow while landing and severely damaged the left landing gear and wing. After learning of the crash, Steeves and some co-workers flew up to the site to see if they could salvage the craft. Working on and off for three weeks in temperatures that reached 60 below, they managed to fabricate parts for the gear and repair the wing. Steeves and two pilots ferried the craft to Edmonton, where they picked up 10,000 pounds of freight and 10 more workers. All went fine until the transport hit a downdraft over Reno. “That plane dropped 1,000 feet straight down,” recalls Steeves. “My head was stuck to the ceiling. When Jack [pilot Jack Martin] finally got the plane under control...he looked back at me and said, ‘I guess that left wing is all right.’ I said, ‘Left wing, hell—I was worried about the one that Douglas put on!’”

The museum, now named after founding curator Baker, also includes hundreds of archival documents. From the 1948 file is a confidential draft of a Congressional bill proposing the use of civilian air cargo services like the Flying Tiger Line in military emergencies. The Congressmen who co-authored the bill: Lyndon Johnson of Texas and John F. Kennedy of Massachusetts.

Prominent among the documents is a letter dated 1945 that was typed on plain, slightly smudged paper. The writer was a young pilot, just back from the war, newly married, and scrambling to find work. The letter is addressed to a California businessman interested in transporting cut flowers by air. It reads, in part: “I would like to know how much weight you would like to ship and some idea of what you could afford to pay and still make a profit. I am very much interested in starting a business of this kind...and upon receipt of the above information will explore the possibility of obtaining aircraft.”

Robert Prescott may not have known what he was starting when he wrote that letter. But thanks to the Flying Tiger museum, future generations will.

—Lance Thompson



A lot of people
don't think twice about their clean water supply.
We must be doing something right.

Did you know there's not one more drop of water on Earth today than when it came into being? And while that's a lot of water, only 3% of it is fresh. Take away what's locked in icecaps and glaciers and you're down to less than 1%. Not exactly an unlimited supply, considering everything you need it for. Not to mention what's necessary for irrigation and industry.

But before you start stockpiling, there are some good reasons to feel confident about your clean water supply. Like what we're doing. In towns across the country, we make it possible to treat wastewater to the point it can be returned to waterways cleaner than the waterways themselves. We purify the drinking water for over a half million people. And for industries that need it, we even ultra-purify water.

Altogether, we treat or purify over 370 million gallons of water every day. We may not be able to make more water. But we make more of it clean.

What business do we have saying we help the environment? That is our business.

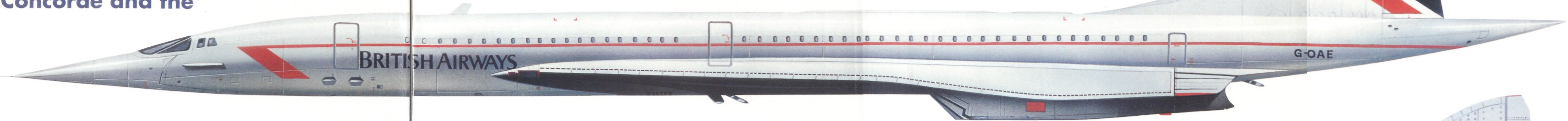


Wheelabrator Technologies
A WMX Technologies Company

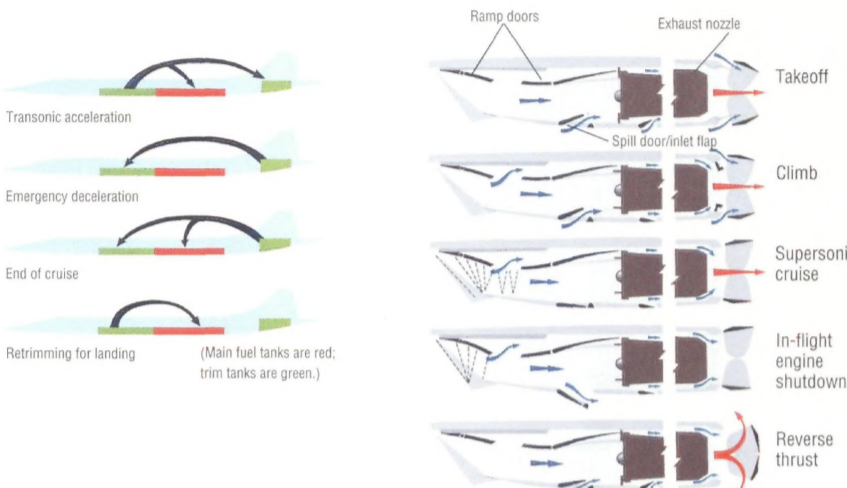
Capable of speeds above Mach 2, the Concorde and the

Tu-144 are the fastest airliners ever built. Twenty-five years after their debuts, the one-time rivals are still the world's only supersonic transports.

THE SSTs

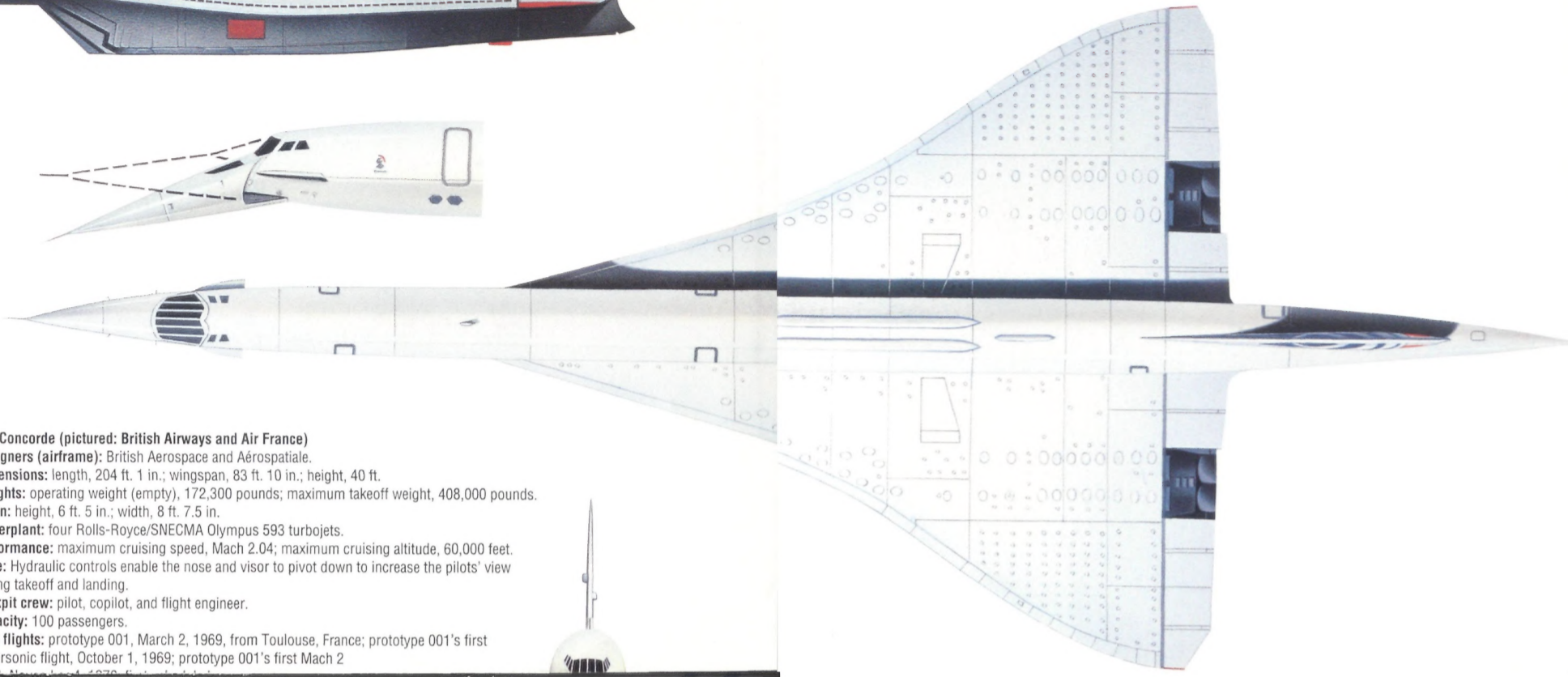


When the Concorde accelerates from subsonic to supersonic speeds, the center of lift gradually moves to the rear, pitching the aircraft nose down. To counteract this, fuel is transferred aft, moving the center of gravity forward. During deceleration to subsonic speeds, fuel is pumped in the reverse direction. Without this ability to alter its center of gravity, the Concorde would pitch up in the more conventional way, by the movement of the tail surfaces, which would create a substantial drag.



Supersonic flight requires adjustments in the engine's air intake throat, which varies the airflow by raising and lowering two ramp doors at the intake's roof and opening and closing a spill door in the floor. In subsonic flight, the ramp doors are fully open, but once the Concorde has accelerated past Mach 1.3, the ramp doors are lowered, creating a series of shock waves (dotted lines) that decelerates the flow of air to Mach 1.5 before it enters the engine.

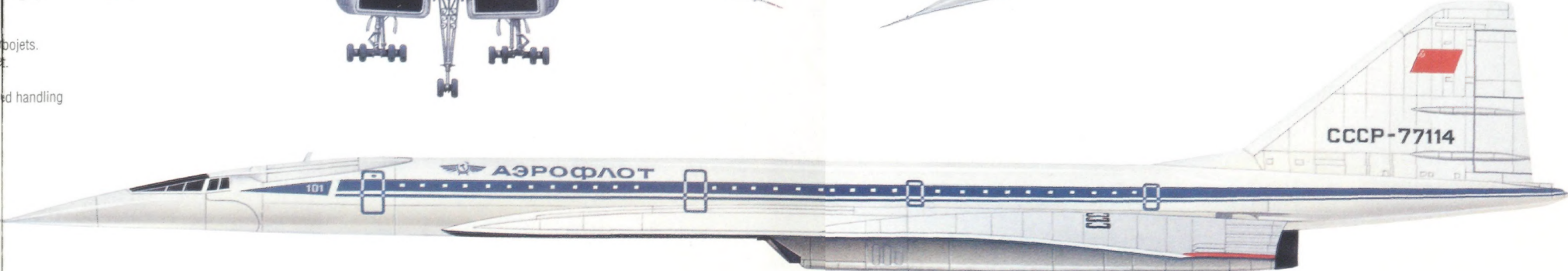
The Concorde (pictured: British Airways and Air France)
Designers (airframe): British Aerospace and Aérospatiale.
Dimensions: length, 204 ft. 1 in.; wingspan, 83 ft. 10 in.; height, 40 ft.
Weights: operating weight (empty), 172,300 pounds; maximum takeoff weight, 408,000 pounds.
Cabin: height, 6 ft. 5 in.; width, 8 ft. 7.5 in.
Powerplant: four Rolls-Royce/SNECMA Olympus 593 turbojets.
Performance: maximum cruising speed, Mach 2.04; maximum cruising altitude, 60,000 feet.
Nose: Hydraulic controls enable the nose and visor to pivot down to increase the pilots' view during takeoff and landing.
Cockpit crew: pilot, copilot, and flight engineer.
Capacity: 100 passengers.
First flights: prototype 001, March 2, 1969, from Toulouse, France; prototype 001's first supersonic flight, October 1, 1969; prototype 001's first Mach 2 flight, November 4, 1970; first scheduled service flight, January 21, 1976; first flight of G-BOAE (pictured above), March 17, 1977.
Number produced: two pre-production prototypes, two production test aircraft, 14 production aircraft.



СССР

77114

The Tu-144 (pictured: Tu-144D)
Designer (airframe): Tupolev Experimental Construction Bureau.
Dimensions: length, 215 ft. 6.5 in.; wingspan, 94 ft. 6 in.; height, 43 ft. 2 in.
Weights: operating weight (empty), 187,400 pounds; maximum takeoff weight, 396,830 pounds.
Cabin: height, 6 ft. 4 in.
Powerplant: four Kuznetsov NK-144 turbofans; Tu-144D: four RD-36-51 (Kolesov) turbojets.
Performance: maximum cruising speed, Mach 2.35; maximum cruising altitude, 59,000 feet.
Nose: To increase the pilots' view during takeoff and landing, the nose and visor pivot down.
Canards: Spanning 20 feet when fully deployed, these small wings generate lift and improve low-speed handling during takeoffs and landings.
Cockpit crew: Pilot, copilot, and flight engineer.
Capacity: 140 passengers.
First flights: prototype, December 31, 1968; prototype's first supersonic flight, June 5, 1969; prototype's first Mach 2 flight, May 26, 1970 (all three flights were world firsts for a civilian airliner); first scheduled passenger flight, November 1, 1977.
Number produced: one static airframe (no engines), one prototype, one pre-production aircraft, two production test aircraft, 14 production aircraft.



Errand Space.



The New Dodge Caravan

YES, IT FITS IN YOUR GARAGE.
NO, IT DOESN'T ENJOY BEING COOPED UP.



Even though the new 4-Door Chevy Tahoe 4x4 is one of the world's largest full-size sport utility vehicles, it still fits comfortably right next to your other car.

But you won't want to keep it there. Its 5.7 Liter V8 engine and Insta-Trac 4-wheel-drive system practically beg for a challenge.

But Tahoe knows that not every driveway leads to a cabin in the woods. So as much as it enjoys the view from a scenic vista, there is something to be said for covered parking.

For a free Tahoe brochure or video, please call

1-800-950-TAHOE.

